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MUSIC MOUNTAIN OIL POOL

AND OTHER OIL POOLS IN LAFAYETTE TOWNSHIP

McKEAN COUNTY, PENNSYLVANIA

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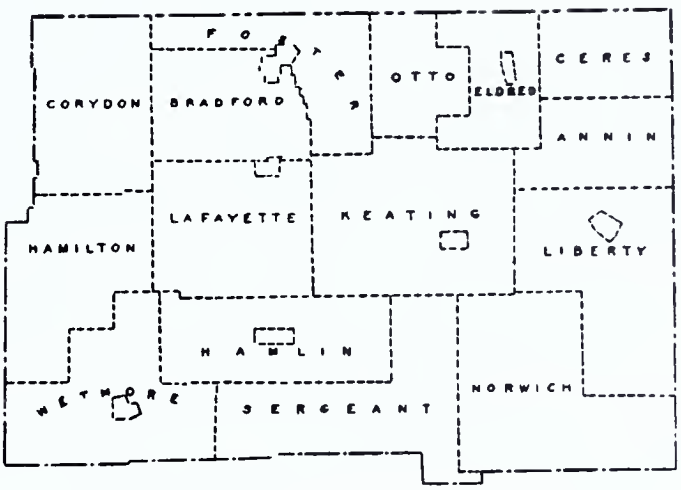

Map of McKean County townships.

CONTENTS

	Page
Introduction	1
Topography and drainage	1
Surface stratigraphy	1
Pennsylvanian system, Pottsville series	1
Mississippian system, Knapp formation	2
Upper Devonian series, Conewango group	2
Oswayo formation	2
Cattaraugus formation	2
Subsurface stratigraphy	3
Conneaut group	3
Canadaway group	3
Structure	6
Oil and gas sands	6
Selected well records	8
Description of oil and gas sands	23
Bradford First sand	23
Sugar Run sand	23
Chipmunk sand	23
Bradford Second sand	23
Harrisburg Run sand	23
Sliverville sand	23
Bradford Third sand	28
Lewis Run sand	29
Kane sand	29
Haskell sand	29
Description of individual pools	29
Music Mountain pool	29
Marshburg pool	31
Bradford pool	32
Guffey pool	32
Lewis Run pool	32
Potential oil- and gas-producing areas	32
Acknowledgments	34

ILLUSTRATIONS

Figure 1.	Oil and gas map of Lafayette Township, McKean County	7
2.	S. W.-N. E. section, Warrant 3404—Warrant 2278	21
3.	N. W.-S. E. section, Warrant 4910—Warrant 3903	22
4.	Section and porosity profile of Williams Producing Company No. 1 well	25
5.	Section made from drill cuttings, Music Mountain pool	26
6.	S. W.-N. E. section, Music Mountain pool	27
7.	N. W.-S. E. section, Music Mountain pool	28
8.	Map of Music Mountain oil pool	29
9.	Estimated average daily oil production by months, Music Mountain pool	30

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INTRODUCTION

Lafayette Township includes an area of approximately 75 square miles in the west-central part of McKean County, the third county east from Ohio on the northern tier. Inasmuch as the southeast lobe of the famous Bradford oil pool and the northern part of the Guffey pool lie within its borders, the oil and gas resources of the township have been developed and exploited for nearly 65 years. The productive acreage in the Bradford Third sand, the producing horizon of the Bradford and Guffey pools, had been defined by the end of the last century. Only a limited amount of prospecting, conducted in a rather desultory fashion, was carried on thereafter. Within the township this led in 1909 to the discovery of an oil-bearing horizon, the Lewis Run sand, about 100 feet below the Bradford Third, in the area occupied by the Lewis Run pool in the northeastern part of the township; and late in 1929 to the discovery of a small Bradford Second sand pool in the vicinity of Marshburg in the northwestern part of the township.

Active interest in the possibilities of the existence of undeveloped reserves of oil in the township was revived on August 24, 1937 when a wildcat well of the Niagara Oil Corporation, located on its Sliverville property on Music Mountain, nine miles south of Bradford, unexpectedly encountered an open flow of 44 barrels of oil per hour at a horizon approximately 240 feet above the Bradford Third sand. The discovery led to the opening of the Music Mountain pool, approximately 670 productive acres in a "shoestring" type of sand body. About 200 producing wells, including several gas wells, have been drilled in this area. The largest oil well was reported to have had an initial open flow capacity of 600 barrels per hour, and some of the gas wells made as high as 15,000,000 cubic feet in 24 hours.

TOPOGRAPHY AND DRAINAGE

Most of Lafayette Township is an undulating upland, between 2,100 and 2,200 feet above sea level, that forms the divide between Tunungwant and Kinzua Creeks, both tributaries of the Allegheny River. Around the northern, western, and southern margins of the township, the East Branch of Tunungwant Creek, Kinzua Creek, and their tributaries have carved deep, narrow valleys out of the upland surface. The maximum relief is nearly 800 feet. Most of the area is wooded, only a very small part of the upland being under cultivation at present. With the exception of a short stretch along the East Branch of Tunungwant Creek near Lewis Run, the valleys are too narrow and steep-walled to afford any land suitable for agricultural purposes.

SURFACE STRATIGRAPHY

The consolidated strata exposed within the limits of Lafayette Township range in age from lower Pennsylvanian to upper Devonian in descending order.

PENNSYLVANIAN SYSTEM

Pottsville Series

The upland surface of Lafayette Township is underlain by sandstones and shales of the Pottsville series. Sandstones, frequently conglomeritic, predominate but some greenish-gray sandy shales, dark gray to black shales,

and occasional thin seams of coal are also present. Coal was formerly obtained from the Pottsville near Mount Alton and Lafayette Corners, but the workable areas are about exhausted. The Olean conglomerate constitutes the basal member of the series. The maximum thickness of the series in the township is about 190 feet. Marine fossils are absent.

MISSISSIPPIAN SYSTEM

Knapp Formation

The Olean conglomerate rests unconformably upon strata of lower Mississippian age. The beds below the unconformity were tilted southward, probably folded slightly, and truncated by erosion before the Pottsville rocks were deposited upon them. In Lafayette Township only the lowermost formation of the Mississippian system, the Knapp, remains.[1]

The Knapp formation, like the Pottsville, consists mostly of sandstone with some interbedded gray shale and siltstone, but the texture of the sandstones commonly is finer. Marine fossils are sparingly distributed throughout its entire thickness and certain layers are abundantly fossiliferous. A prominent flat-quartz-pebble conglomerate locally occurs at the base of the Knapp formation in Lafayette Township. An unusually fine exposure of this conglomerate occurs above the State highway just north of Tallyho on the east side of Wintergreen Run near its mouth. The bed here is 14 feet thick. Due to the beveling of the gently southerly-dipping strata by the Mississippian-Pennsylvanian unconformity, the interval from the base of the Olean conglomerate to the base of the Knapp increases from 100 feet in the northern part of the township to nearly 200 feet in the southern part.

UPPER DEVONIAN SERIES

Conewango Group

The Conewango group in Lafayette Township is represented by two formations, the Oswayo and the Cattaraugus in descending order.

Oswayo formation. The Oswayo formation comprises the greenish-gray sandy marine shales with interbedded shaly and frequently fossiliferous sandstone layers beneath the Knapp and above the Cattaraugus red beds. The formation is about 220 feet thick in the township. About 60 feet above the base of the Oswayo, locally there occurs a limestone from one to three feet thick which Ashburner called the Marvin Creek.[2] It consists largely of broken brachiopods and other marine shells imbedded in a sandy matrix.

Cattaraugus formation. The Cattaraugus formation consists of about 300 feet of red shales interbedded with greenish-gray shales and fine-grained, greenish-gray, thin-bedded, micaceous sandstones. In Lafayette Township, the Tuna (Killbuck) conglomerate, which marks the top in Cattaraugus County, New York, and the Wolf Creek conglomerate at the base are not well developed and may be absent. The dividing line between the Oswayo and Cattaraugus has been drawn at the top of the highest red shale; the lowermost red shale has been taken as the base of the formation. The red shales of the Cattaraugus formation comprise the "red rock" recorded by the drillers in their logs. Certain layers in the Cattaraugus are rich in marine fossils. The base of the Cattaraugus formation sinks below stream level along the East Branch of Tunungwant Creek at Lewis Run.

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[1] Butts, Charles, Pre-Pennsylvanian stratigraphy: Topog. and Geol. Survey of Pennsylvania, Report 1906-08, pp. 192-193.

Caster, Kenneth E., Stratigraphic relationships in northwestern Pennsylvania (abstract): Geol. Soc. of America Bull., vol. 44, pp. 202-203, 1933.

[2] Ashburner, C. A., The Geology of McKean County: Pennsylvania Second Geol. Survey, Report R, pp. 68-69 and 167, 1880.

SUBSURFACE STRATIGRAPHY

CONNEAUT GROUP[3]

The Conneaut group includes the interbedded greenish-gray and gray shales and sandy shales, fine-grained light gray sandstones, and purplish-gray shales, referred to as "pink rock" by the drillers, that comprise the strata between the lowermost red shales of the Cattaraugus formation and the base of the Bradford First sand. All of the strata are of marine origin. The Bradford First sand has been correlated with the Cuba sandstone of Cuba, Allegany County, New York.[4] In Lafayette Township, the Conneaut group has a thickness of approximately 700 feet.

CANADAWAY GROUP[5]

The Canadaway group includes the strata between the base of the Bradford First sand and the base of the Dunkirk black shale. All of the present producing oil and gas sands in Lafayette Township occur in it. The Canadaway group consists of interbedded greenish-gray and gray shales and sandy shales, fine to coarse-grained light gray sandstones, and fine-grained light brownish-gray to chocolate-brown sandstones, all deposited under marine conditions. Very few, if any, wells drilled in Lafayette Township have reached the horizon of the Dunkirk black shale. In the northern part of the Bradford district, the group has a total thickness of approximately 1,400 feet.

A detailed description is given below of the strata penetrated in the Catherine P. Horton No. 1 well located in Warrant 3435 (101, Fig. 1). This was compiled from a study of a complete set of drill cutting samples and shows the lithologic characteristics and the thicknesses of the Pennsylvanian, Mississippian, and Upper Devonian beds through the upper one-fourth of the Canadaway group.

Catherine P. Horton No. 1 well
Warrant 3435, Lafayette Township, McKean County

Drilled in 1938. Elevation 2180 feet. Record of Arthur C. Simmons et al.

Thickness Feet	Description of strata	Depth in feet Top	Bottom
35	No samples	0	35
20	Sandstone, medium-grained, light gray	35	55
5	Sandstone, fine-grained, grayish-brown, with considerable interbedded very dark gray, almost black shale	55	60
5	Sandstone, fine-grained, grayish-brown, containing muscovite	60	65
6	Shale, dark gray	65	71
8	Shale, very dark gray to black	71	79
16	Sandstone, fine to medium-grained, light greenish-gray	79	95
20	Sandstone, medium-grained, light gray, almost white	95	115
9	Sandstone, fine-grained, greenish-gray	115	124
11	Shale, greenish-gray, sandy	124	135
40	Sandstone, very coarse-grained, light gray, almost white, contains angular quartz pebbles up to 7 millimeters in diameter.	135	175
7	Sandstone, medium to coarse-grained, light gray	175	182
5	Sandstone, fine to medium-grained, light gray, slightly calcareous	182	187
	Bottom of Pottsville series, top of Knapp formation.		
5	Shale, gray, with some calcareous and iron carbonate concretions containing fragments of shells	187	192
5	Siltstone, greenish-gray, somewhat calcareous	192	197
13	Sandstone, very fine-grained, somewhat calcareous, with some interbedded gray shale	197	210
20	Sandstone, medium-grained, light greenish-gray, somewhat calcareous, with some interbedded dark gray shale	210	230

[3] Chadwick, G. H., Faunal differentiation in the Upper Devonian: Geol. Soc. of America Bull., vol. 46, p. 326, 1935.

[4] Fettke, Chas. R., The Bradford Oil Field, Pennsylvania and New York: Pennsylvania Geol. Survey, 4th ser., Bull. M 21, p. 147, 1938.

[5] Chadwick, G. H., op. cit., p. 323.

Thickness Feet	Description of strata	Depth in feet Top	Bottom
5	Sandstone, fine-grained, light greenish-gray, with some interhedded gray shale	230	235
11	Sandstone, fine-grained, greenish-gray, somewhat calcareous, containing fragments of shells	235	246
36	Sandstone, fine-grained, light greenish-gray	246	282
12	Sandstone, medium to coarse-grained, greenish-gray, somewhat calcareous, containing some flat quartz pebbles up to 7 millimeters in diameter, with some interbedded gray shale	282	294
	Bottom of Knapp formation, top of Oswayo formation.		
6	Sandstone, fine-grained, light greenish-gray, somewhat calcareous, with some interbedded gray shale	294	300
8	Sandstone, fine-grained, light gray, with some interbedded gray shale	300	308
28	Sandstone, fine-grained, greenish-gray, with some interbedded gray shale	308	336
12	Shale, dark greenish-gray, sandy	336	348
6	Shale, greenish gray	348	354
40	Sandstone, very fine-grained, greenish-gray, with some interbedded gray shale	354	394
29	Sandstone, very fine-grained, light greenish-gray, with a little interbedded gray shale	394	423
21	Shale, greenish-gray, sandy, containing minute carbonized plant fragments	423	444
14	Sandstone, fine to medium-grained, light greenish-gray, somewhat calcareous, containing fragments of shells	444	458
33	Shale, greenish to dark greenish-gray, with some interbedded fine-grained, light greenish-gray sandstone	458	491
25	Shale, greenish-gray, sandy	491	516
	Bottom of Oswayo formation, top of Cattaraugus red beds.		
5	Shale, brick-red	516	521
25	Shale, greenish-gray, sandy	521	546
6	Shale, brick-red	546	552
12	Shale, greenish-gray, sandy, with a little interbedded brick-red shale	552	564
16	Sandstone, fine-grained, greenish-gray, containing muscovite.	564	580
14	Shale, greenish-gray, sandy, with some interbedded brick-red shale	580	594
6	Shale, brick-red	594	600
6	Shale, dark greenish-gray	600	606
7	Shale, greenish-gray, sandy	606	613
7	Shale, gray	613	620
7	Shale, brick-red	620	627
27	Shale, dark greenish-gray, sandy, with some interbedded brick-red shale	627	654
26	Shale, greenish to dark greenish-gray	654	680
8	Shale, dark greenish-gray, sandy, with some interbedded red sandy shale	680	688
20	Sandstone, very fine-grained, light greenish-gray, with considerable interbedded greenish-gray shale	688	708
11	Shale, brick-red	708	719
56	Shale, dark greenish-gray with some interbedded greenish-gray sandy shale	719	775
22	Shale, brick-red, in part sandy	775	797
	Bottom of Cattaraugus red beds, top of Conneaut group.		
15	Shale, greenish-gray	797	812
29	Sandstone, very fine-grained, greenish-gray, with some interbedded gray shale	812	841
8	Sandstone, fine to medium-grained, light greenish-gray, somewhat calcareous	841	849
31	Shale, dark gray	849	880
33	Shale, dark greenish-gray, sandy, containing fragments of shells	880	913
10	Shale, gray	913	923
	Top of "pink" rock.		
33	Shale, dark greenish-gray, sandy, with some interbedded purplish-gray shale	923	956
29	Shale, dark greenish-gray, sandy, containing fragments of shells	956	985

Thickness Feet	Description of strata	Depth in feet Top	Bottom
10	Shale, dark greenish-gray, with some interbedded dark purplish-gray shale	985	995
20	Shale, dark greenish-gray, sandy	995	1015
8	Siltstone, dark greenish-gray	1015	1023
9	Shale, dark greenish-gray, with some interbedded dark purplish-gray sandy shale	1023	1032
7	Shale, dark greenish-gray, sandy	1032	1039
4	Siltstone, greenish-gray, with abundant fragments of shells	1039	1043
25	Shale, dark greenish-gray, sandy with some interbedded dark gray shale	1043	1068
19	Shale, dark greenish-gray, with some interbedded dark purplish-gray shale	1068	1087
10	Shale, dark purplish-gray	1087	1097
29	Shale, dark greenish-gray, sandy	1097	1126
32	Shale, dark purplisb-gray, with considerable interbedded dark greenish-gray sandy shale	1126	1158
7	Sbale, dark purplish-gray, sandy	1158	1165
20	Shale, dark gray, with some interbedded greenish-gray sandy shale	1165	1185
41	Sbale, dark purplish-gray, sandy	1185	1226
	Bottom of "pink" rock.		
37	Shale, dark greenish-gray, with some interbedded greenish-gray sllltstone containing fragments of shells	1226	1263
69	Shale, dark greenish-gray	1263	1332
18	Shale, dark greenish-gray, sandy	1332	1350
105	Shale, dark greenish-gray, with some interbedded dark greenish-gray siltstone containing fragments of shells	1350	1455
	Top of Bradford First sand.		
22	Sandstone, very fine-grained, light greenish-gray, slightly calcareous, with some interbedded gray shale	1455	1477
11	Shale, dark greenish-gray, with considerable interbedded greenish-gray siltstone	1477	1488
15	Sandstone, fine-grained, light greenish-gray, slightly calcareous, with a little interbedded dark greenish-gray shale	1488	1503
	Bottom of Bradford First sand.		
	Bottom of Conneaut group, top of Canadaway group.		
38	Shale, greenish-gray	1503	1541
8	Shale, greenish-gray, with considerable interbedded fine to coarse-gralned light grayish-brown sandstone	1541	1549
39	Shale, dark greenish-gray	1549	1588
20	Shale, dark greenish-gray, witb considerable interbedded fine-grained, light greenish-gray sandstone	1588	1608
6	Sandstone, fine-grained, ligbt greenish-gray; Chipmunk sand	1608	1614
40	Sbale, dark greenish-gray	1614	1654
22	Shale, dark greenish-gray, with some interbedded very fine-grained, light greenish-gray sandstone	1654	1676
70	Sbale, dark greenish-gray	1676	1746
	Top of Bradford Second sand.		
5	Sandstone, very fine-grained, light greenish-gray	1746	1751
5	Sandstone, fine-grained, light greenish-gray; show of gas	1751	1756
9	Sandstone, very fine-grained, light brownish and greenish-gray	1756	1765
	Bottom of Bradford Second sand.		
20	Shale, greenish-gray	1765	1785
9	Sandstone, very fine-grained, light grayish-brown, slightly calcareous; show of oil; Harrisburg Run sand	1785	1794
16	Shale, greenish-gray	1794	1810
10	Sandstone, medium-grained, light gray, with a great deal of interbedded greenish-gray shale; Sliverville sand	1810	1820
19	Shale, dark greenish-gray, with a little interbedded fine-grained, ligbt greenish-gray sandstone	1820	1839
9	Shale, dark gray	1839	1848
13	Shale, greenisb-gray	1848	1861
17	Shale, dark greenish-gray	1861	1878
	Total depth		1878

STRUCTURE

A structure map of Lafayette Township, Figure 1, has been prepared which shows the elevation of the top of the Bradford Third sand above sea level by means of 20-foot contours. The major northeast-southwest folds of the Bradford district, namely, the Bradford anticline, Big Shanty syncline, and Simpson anticline, extend across the township between its northwestern and southeastern borders. The steeply southwestward plunging Bradford anticline is the most prominent feature, the Big Shanty syncline and the Simpson anticline being developed only as very broad and gentle folds. Major structures as mapped on the erosion surface at the base of the Olean are essentially parallel to those mapped on the top of the Bradford Third sand. This indicates that the present structural features of the Bradford Third sand were, in part at least, developed in post-Pottsville time.

OIL AND GAS SANDS

The oil and gas sands of Lafayette Township are disconnected lenses, not continuous bodies of sandstone. Each sand consists of lenses that occur within a relatively narrowly restricted vertical zone in the Canadaway group. Even the most extensively developed Bradford Third sand, when studied in its broader aspects, is found to possess this lenticular character. On account of the narrow interval between some of the zones, correlation of a sandstone lens in one pool with that of another lens at about the same stratigraphic horizon in a near-by pool can be only approximate.

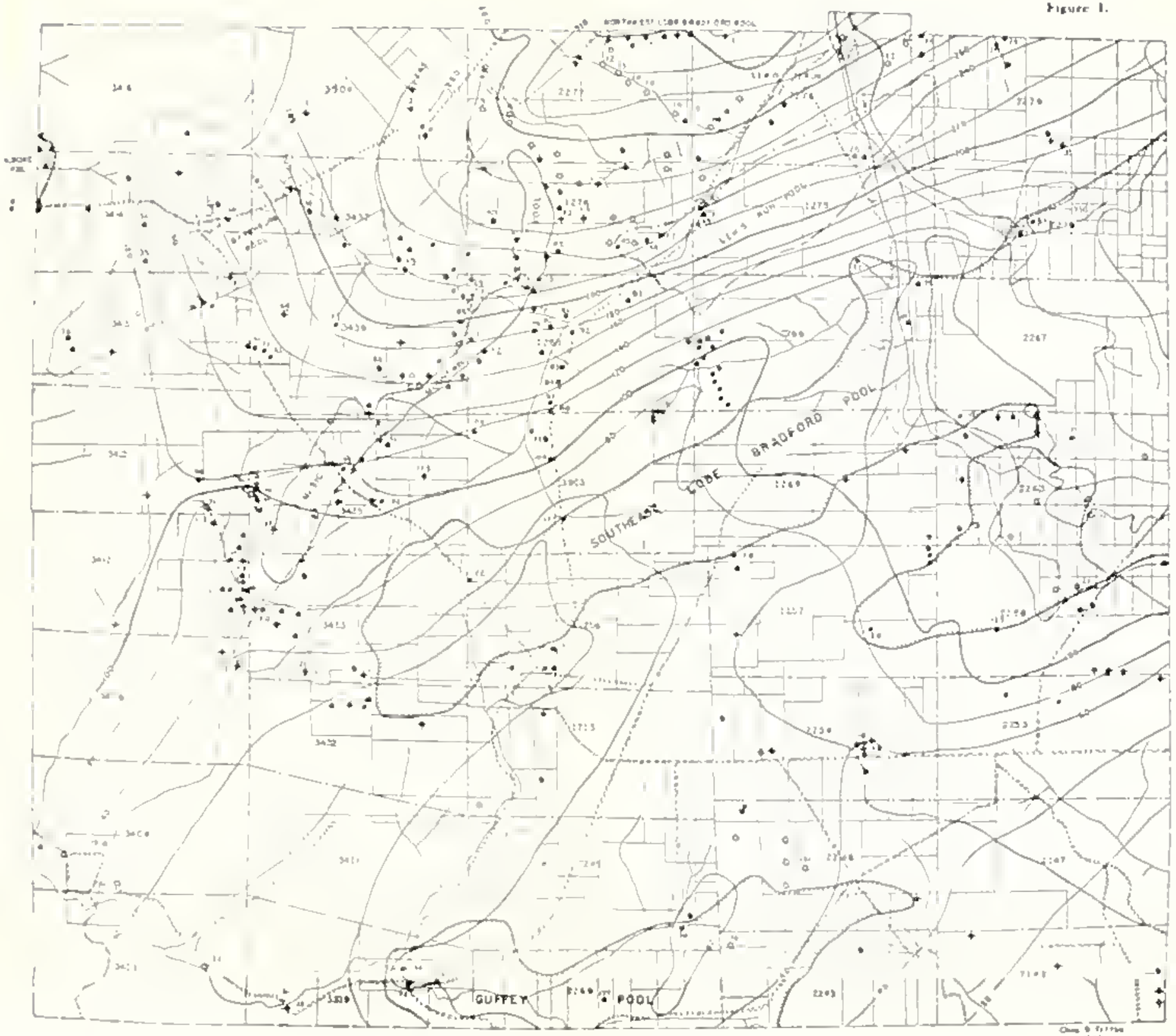
The oil and gas sands of the Canadaway group were deposited under marine conditions. At the time this occurred, a shallow sea covered the area. The shore line of this ancient sea probably was no very great distance to the east and southeast. Streams rising in the old land mass of Appalachia along the eastern margin of the continent and flowing westward across a low-lying alluvial plain, the Catskill delta plain, washed sediments, including sand, silt, and clay, into it. The sand accumulated in greatest volume opposite the mouths of the larger streams and the finer material was washed farther out into the sea. Waves, tidal currents, and shore currents played an important role in further sorting the sand from the silt and clay and distributing it more widely over the shallow sea-floor off shore. The position of the mouths of the streams that brought in the sediments, the contour of the shore line, the configuration of the sea-floor, the direction and strength of wave, tidal, and long shore currents were all factors in determining the texture, degree of sorting, shape, size, thickness, distribution, and trends of the sand bodies as they occur today.

The sand bodies were laid down not as continuous sheets but as elongated lenses. Some represent ancient off-shore bars. Others resemble in outline and size the barchane or dune-like bodies of sand that occur on the floor of the North Sea near the French and Netherland coasts. The formation of these has been attributed to tidal currents.[6] Only locally did sorting develop sufficient porosity and permeability in the sand bodies to make them suitable reservoir rocks for the accumulation of commercial deposits of oil and gas. The position and configuration of the shore line changed as deposition went on. As a result, the belts along which the productive pools occur in the various zones do not overlap one another to any great extent.

Of the wells shown on the oil and gas map of Lafayette Township (Fig. 1), the records of 138 that contained the most information were selected for correlation purposes. These have been compiled in Table 1. They are numbered in consecutive order from west to east by warrants, starting at the north.

[6] Edelman, C. H., Petrologic relations of the sediments of the southern North Sea; Recent Marine Sediments, Amer. Assoc. Petroluem Geologists, pp. 346-347, 1939.

Figure 1.



LEGEND

- Sugar Run Sand pool
- Bradford Second Sand pool
- Shinnemahoning Sand pool
- Bradford Third Sand pool
- Lewis Run Sand pool

OIL AND GAS MAP OF LAFAYETTE TOWNSHIP,
MC KEAN COUNTY, PENNSYLVANIA.

Scale
6000 10,000 Feet

Structure contours on top of Bradford Third Sand
Contour interval 20 feet

LEGEND

- Oil well
- Gas well
- Dry hole

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*Table 1. Selected well records, Lafayette Township.**

Map number ..	1	2	3	4	5
Warrant number.	3904	3904	3904	3904	2277
Property and number .	No. 30	Van Scoy No. 2	Van Scoy No. 1	No. 29	No. 29
Owner	South Penn Oil Company			South Penn Oil Company	Lewis Run Mfg. Co.
Elevation	2176	2146	2163	2199	2181
Drive pipe					16
Casing			300	400	342
Bottom of Olean.					
"Red rock"		White sand-500-			
"Pink rock" ..		Sand-700-	Sand 700-		
Sands:					
Bradford First.					
Sugar Run ...		1310	1280		1295-1335
Chipmunk	1470-1520	gas sand 1420-	1415-1433	1460-1520	1435-1470
		oil sand 1460-	1455-1477†		gas
Bradford Second					1595-1625
Harrisburg Run.					
Sliverville					
Bradford Third.	1940-2003	1904-1968		1936	1895-1939
	s.w. 1970	s.w. 1945			
Lewis Run					
Kane					
Haskell					
Total depth ..	2003		1477		
Date completed					

* s.w.—salt water, M.—1,000 cubic feet, small oil—producer, prod.—producer.
† Hard sand 1415-1433, pebbly sand 1455-1477; a little gas in each.

Map number ..	12	13	14	15	16
Warrant number.	2277	2277	2277	2277	2277
Property and number .	No. 53	No. 52	No. 38, Lot 137	No. 37, Lot 141	No. 36, Lot 148
Owner	Lewis Run Mfg. Co.	Lewis Run Mfg. Co.	Lewis Run Mfg. Co.	Lewis Run Mfg. Co.	Lewis Run Mfg. Co.
Elevation					
Drive pipe	41	45		50	
Casing	325	285	250	294	275
Bottom of Olean.					
"Red rock"					
"Pink rock" ..					
Sands.					
Bradford First.					
Sugar Run ...	1150-	1130-	1100-1120		925-
		a little gas	dry		
Chipmunk	1250-				
	shaly, dry				
Bradford Second					
Harrisburg Run.					
Sliverville					
Bradford Third.	1685-1735, s.w.	1623-1670	1584-1614	1545-1565	1430-1449
	show oil, 1705	s.w., show oil	good show oil	s.w., show oil	1470-
Lewis Run	1831-1843	1762-1773	1716-1724	1677-1685	1545-1552
	390 M. gas	65 M. gas	gas	gas	gas
Kane					
Haskell					
Total depth ..	1862	1796	1737	1690	1565
Date completed			Dec. 1902	Oct. 17, 1902	Aug. 2, 1901

6	7	8	9	10	11
2277 No. 28	2277 Brown 4	2277 No. 33	2277 No. 31	2277 No. 30	2277 No. 21
Lewis Run Mfg. Co.	Minard Run Oil Company	Lewis Run Mfg. Co.	Lewis Run Mfg. Co.	Lewis Run Mfg. Co.	Lewis Run Mfg. Co.
2124 50 349	230	2254	2246 14 400	2073 24 400	1878 54 345
1190-	1150-				920
1345-1354 gas		1445-		1245-1255	
	1450-				1220-
	1750-1792 show oil, s.w.	1913-1953 s.w.	1901-1944	1723-1754	1527-1557
	1893-1903 20 M. gas		2039- show of gas	1867-1874	1667-1675
1374 Sept. 1894	Nov. 11, 1916	1994 Oct. 1, 1895	2050	1900	1689 Feb. 11, 1891

17	18	19	20	21	22
2278 o. 10, Lot 153	2278 W. A. Foster No. 22	2278 H. B. Cannon No. 2	2278 Lafayette Mfg. Co. No. 1	2278 Lafayette Mfg. Co. No. 2	2278 No. 2
Lewis Run Mfg. Co.	Lewis Run Mfg. Co.	H. B. Cannon	Bryner and Emery	Bryner and Emery	Alumina Shale Brick Company
1649 215	1634 240	1560 83 330	1548 130 325	1549 145 436	1660 20 306
		Top 310' above well			
	725-785				
	1025-1040	920-940 show of oil 985-987	895-924 oil† 967-971, dry	891-916	1055-1085 dry
1289-1309 oil	1325-1330	1240-1260 shale, dry		1230-1236 1260-1266	1373-1394
1417-1427	1430-1443 gas	1332-1339 some gas		1327-1335 50 M. gas	1462-1471 50 M. gas
	1484	1360 April 1, 1909	979 May 22, 1909	1435 June 10, 1909	1490 July 14, 1908

† Begun 100 bbls. oil, settled to 2 bbls.

Table 1. Selected well records, Lafayette Township—Continued

Map number ..	23	24	25	26	27
Warrant number.	2278	2278	2278	2278	2278
Property and number ..	No. 1	Moody 142, Lot 43	Moody 164, Lot 43	Moody 147, Lot 71	Moody 211, Lot 71
Owner	Alumina Shale Brick Company	Minard Run Oil Company	Minard Run Oil Company	Minard Run Oil Company	Minard Run Oil Company
Elevation	1638	1665		1661	1628
Drive pipe	47	53	54	110	182
Casing	297	338	355	510	618
Bottom of Olean.					
"Red rock"					
"Pink rock" ...					
Sands:					
Bradford First.					
Sugar Run ...					810-840
Chipmunk					
Bradford Second				1140-1170	1069-1100
Harrisburg Run.	1082-1085	1122-1128			
Sliverville			Stray 1420-1430		Stray 1360-13
Bradford Third.	1347-1368 gas, no oil	1380-1405 show gas and oil	1470-1490 some oil	1431-1448 no oil	1380-1390
Lewis Run	1436-1442 90 M. gas	1464-1475	1553-1563 20 M. gas	1513-1520 oil	1478-1487 oil
Kane		Stray 1515-1533	Stray 1604-1616	Stray 1734-1755	
Haskell					
Total depth ..	1454	1933	1621	1772	1537
Date completed	June 19, 1908	1908	Feb. 5, 1913		

Map number ..	34	35	36	37	38
Warrant number.	3414	3414	3414	3437	3437
Property and number .	Johnson No. 1	Johnson No. 2	Geo. B. Haines No. 2	Hamlin 1-A Lot 428	Lewis Run M No. 1, Lot 4
Owner	L. E. Mallory and Sons	Roy Phillips	Mallory and Pringle	Mallory and Pringle	Mallory an Pringle
Elevation	2078	2093	2157	2144	2056
Drive pipe	42				
Casing	421		403		395
Bottom of Olean.					44' above w
"Red rock"		494-580			
"Pink rock" ..		1034-1142			
Sands:					
Bradford First.					
Sugar Run ...					
Chipmunk		1518-1557 1564-1573		1516-1526 broken	
Bradford Second	1617-1629 good show oil 1654-1667	1681-1696 1714-1727	1668-1681 oil	1645-1651 ½ bbl. oil	1541-1557 2 bbls. oil
Harrisburg Run.		1753-1781**			
Sliverville		Stray, shot 1817-1833			
Bradford Third.		1970-2062***		1949-1965 s.w. at 1960	1854-1874 dry
Lewis Run					
Kane					
Haskell					
Total depth ..	1689	2086	1710	1965	
Date completed	September 1936	June 1939	Dec. 14, 1936	July 14, 1924	Aug. 20, 19

** Shot 1714-1781. *** Shot; show of oil and gas.

28	29	30	31	32	33
2279 Moody 150, Lot 45	2279 Moody 157, Lot 45	2279 Moody 143, Lot 52	4910 No. 46	3414 No. 47	3414 Schermerhorn No. 1
Minard Run Oil Company	Minard Run Oil Company	Minard Run Oil Company	South Penn Oil Company	South Penn Oil Company	L. E. Mallory and Sons
32 365	39 374	21 413	2080	32 414	26 396
			20		
			1415-1421§	1318-1324¶	
					1691-1703 dry 1727-1733 dry
		Stray 1935-1938			
1790-1800 no oil	1723-1727	2042-2070‡ show oil 2054-2066			
1910-1917 a little oil	1844-1854 a little oil	2120-2144 dry			
	Stray, dry 1901-1911	2300-2335 no oil			
1939 Dec. 8, 1911	1922 July 1, 1912	2535 Feb. 12, 1908	1433	1338	January 1937

‡ Show of oil at 2054-2066. § Oil pay at 1417-1420. ¶ Made 10 bbls. oil at start.

39	40	41	42	43	44
3437 Big Camp 2	2276 W-2	2276 Sliverville 118	2276 Sliverville 119	2276 Miam W-1	2276 Miam W-4
	Healey Petroleum Corp.	Niagara Oil Corp.	Niagara Oil Corp.	Healey Petroleum Corp.	Healey Petroleum Corp.
1817	2163	2132 45 369	2117 55 370	2145 22 303	2153
1035	1320-1342			1318-1346	1320-1348
				1408-1430	1403-1425 shot
1265-	1602-1652			1568-1628	1582-1616
	1899-1938	1886-1911 shot	1877-1899 shot	1878-1904 shot, dry	1885-1916
	2034-2041 show oil—shot	1998-2004 shot, small prod.	1981-1987 shot, small prod.	1994-2000 shot, dry	2002-2006 shot
	2063	2016	2003	2020 Nov. 8, 1937	2006 March 8, 1938

Table 1. Selected well records, Lafayette Township—Continued

Map number ..	45	46	47	48	49
Warrant number.	2276	2276	2276	2275	2275
Property and number ..	No. 9	No. 8	Lewis Run 41	Lewis Run 55	Lewis Run 29
Owner	Lewis Run Mfg. Co.	Lewis Run Mfg. Co.	W. C. Kennedy & Co. and F. D. Wood	W. C. Kennedy & Co. and F. D. Wood	W. C. Kennedy & Co. and F. D. Woo
Elevation	1929	1789	1782	1606	1611
Drive pipe				47	88
Casing	395	400	356	390	577
Bottom of Olean.		365' ft. above well			
"Red rock"					
"Pink rock" ...					
Sands:					
Bradford First.					
Sugar Run ...					
Chipmunk	1196-1214 some gas	1067-1087 gas	1065-1080 a little gas	890-902 a little gas	915-922 dry
Bradford Second			1200-1260 dry	1020-1118 show gas, s.w.	1015-1100 a little gas
Harrisburg Run.					
Sliverville					
Bradford Third.	1675-1700	1548-1569	1540-1560 salt water	1371-1391 s.w., show oil	1390-1411 a little gas, s.
Lewis Run	1765-1775 oil	1633-1643 oil	1638-1644 some oil, s.w.	1452-1459 oil	1468-1476 oil
Kane		Stray, dry 1685-1705			
Haskell					
Total depth ..	1840	1797	1661	1477	1490
Date completed			Feb. 25, 1918		July 14, 191

Map number ..	56	57	58	59	60
Warrant number.	3413	3413	3413	3413	3413
Property and number ..	Lot 20, No. 2	Lot 19, No. 1	Melin & Peterson No. 3, Lot 16	Melin & Peterson No. 1, Lot 16	Melin & Peters No. 2, Lot 1
Owner	E. A. Williams & Sons	E. A. Williams and Sons	Peterson, Hanson, & Ehret	L. E. Mallory and Son	L. E. Mallor & Son
Elevation		2015	2050	2049	2120
Drive pipe	45	38		42	23
Casing	396	407		430	420
Bottom of Olean.				Coal 60-65	
"Red rock"			550-625, 700-750	385-	
"Pink rock" ...			1060-	1082-	
Sands:					
Bradford First.	1220-1305			1265-	
Sugar Run ...	1370-1438	1369-1375 1393-1475	1440-1470	1419-1424 1444-1521	
Chipmunk					
Bradford Second	1510-1580 1595-1620 show oil, shot	1526-1610 shot, gas, show oil 1624-1656	1628-1657 2 bbls. oil	1628-1655 show oil, shot	1634-1639
Harrisburg Run.		1670-1675			1688-1693
Sliverville			Stray 1790-1800		
Bradford Third.		1909-1966			1962-1987 s.w. at 198
Lewis Run		1985-1991			2105-2112 broken
Kane		Stray 2240-2270			Stray 2145-2 broken
Haskell		2400-2425			
Total depth ..	1755	2450	1800	1710	2161
Date completed		1938	1939	Nov. 1, 1934	July 1935

50	51	52	53	54	55
2275	2275	2275	2274	2274	2274
ewis Run 48	Lewis Run 52	Chas. F. Schwab No. 26	Moody Lot 66 No. 21	Moody Lot 57 No. 8	Moody Lot 56 No. 61
. C. Kennedy & Co.	W. C. Kennedy & Co.	W. C. Kennedy & Co.	South Penn Oil Co.	H. G. Barcroft	Grant & Mohan
d F. D. Wood	and F. D. Wood	and F. D. Wood			
1605	1608	2139	1763	1830	2026
55		16	55	59	
419	581	610	354	329	360
		65			54′ above well
			14 ft.‡ above well		
889-900	892-904	1610-1710 dry			
a little s.w.	dry				
1020-1100	1022-1120				
dry	dry			1460-1510	
				show oil	
		Stray 1940			
		Stray 1994-2000			
1364-1384	1370-1390*	2017-2025	1615-1646	1662-1699	1852-1888
how oil & gas	mucb s.w.	shot, ¾ bbl. oil	oil	oil	oil
1448-1454	1458-1464				1960-1972
oil, some s.w.	oil				
		2248-2267			2132-2173
		show oil			
		Stray†			2204-2219¶
1478	1490	2435	1651	1730	2295

* A little gas and much soft water. † Stray 2324-2334 dry; Stray 2402-2416, small show of oil.
‡ Top of Marvin Creek limestone 14 feet above well. ¶ Stray, some gas.

61	62	63	64	65	66
3436	3436	3436	3436	3436	3436
No. 4 Bisbop	No. 3	No. 2	No. 1	Watson No. 5	Watson No. 6
Onofrio & McCarthy	Onofrio & McCarthy	Onofrio & McCarthy	Onofrio & McCarthy	Healey Petroleum Corp.	Healey Petroleum Corp.
2144	2176	2168	2139	2054	2152
	32		19		36
	471		402		300
	Coal 60-70				
1400-1440	1441-1481	1431-1471	1454-1492	1302-1342	
1525-1575	1570-1610	1560-1600		1429-1445	
1740-1753	1736-1748*	1726-1738†	1703-1745	1602-1629	1705-1757
	1751-1793	1743-1771		shot, small prod.	shot, dry
1991-2045			1971-1993	1870-1920	1981-2037‡
			show oil, s.w.		
2128-2136					2096-2104
					dry
		1860	1993	2072	2123
	1861			Feb. 18, 1938	April 1, 1938

* Gray 1736-1748, brown 1751-1793; shot, small producer.
† Gray 1726-1738, brown 1743-1771; shot, small producer.
‡ Slight show oil salt water 2019-2027.

Table 1. Selected well records, Lafayette Township—Continued

Map number ..	67	68	69	70	71
Warrant number.	3436	3436	2265	2265	2265
Property and number ..	No. 1 N. E. cor. Lot 1	No. 1 S. E. cor. Lot 1	Dent-Whitney 61	Dent-Whitney 135	Dent-Whitney 100
Owner	Lafayette Mfg. Co.	Mallory & Williams	Minard Run Oil Co.	Minard Run Oil Co.	Minard Run Oil Co.
Elevation	1779	2089	1787		2104
Drive pipe	50	46		79	
Casing	390	433	417	426	415
Bottom of Olean.					11′ above wel
"Red rock"					
"Pink rock" ...					
Sands:					
Bradford First.				930-940	1322-1332
Sugar Run ...					
Chipmunk	1083-1095 dry	1467-	1135-1155	1080-1086	1494-1502
Bradford Second	1215-1255 15M to 20M gas		1218-1248	1200-1235 show gas	1558-1571
Harrisburg Run.		Brown 1608-1628		brown, dry 1280-1285	1635-1650
Sliverville		1637-1639§		Stray 1417-1423	1656-1700¶
Bradford Third.	1558-1591 salt water		1564-1593 show oil, s.w.	1535-1576 shot, small prod.	
Lewis Run	1672-1680 show oil			1656-1663 shot-dry	
Kane					
Haskell					
Total deptb ..	1739	1702	1950	1693	1708
Date completed	July 1911	April 20, 1938	April 6, 1899	Nov. 23, 1940	May 1938

§ 1800 M. cu. ft. gas, 540 lb. R. P. Blew down to 100 M. and 125 lb. R. P. 1660-1665—small show oil.
¶ 1,000 M. gas and 30 bbl. oil per hr.

Map number ..	78	79	80	81	82
Warrant number.	2265	2265	2265	2265	2265
Property and number ..	Dent-Whitney 71	Dent-Whitney 103	Dent-Whitney 70	Dent-Whitney 75	Dent-Whitney
Owner	Minard Run Oil Co.	Minard Run Oil Co.	Minard Run Oil Co.	Minard Run Oil Co.	Minard Run Oil Co.
Elevation	1703	1873	1686	1677	1687
Drive pipe ...					
Casing	401	395	392	402	410
Bottom of Olean.					
"Red rock"					
"Pink rock" ...					
Sands:					
Bradford First.	921-948, dry	1129-1137	913-	921-961	919-961
Sugar Run ...					
Chipmunk	1033-1048 dry		1043-	1028-1050 sbow oil	1041-1056
Bradford Second	1155-1185 show of gas, a little oil	1356-1372 dry	1155-1186 some gas	1159-1181	1163-1196
Harrisburg Run.	1241-1247 dry	brown 1411-1419			
Sliverville		1442-1449	1245-1260 coarse—gray	1251-1261	
Bradford Third.	1502-1520 show oil, s.w.	1694-1714 some s.w.	1503-1520 show oil, s.w.	1486-1524 some s.w.	1506-1534 some s.w.
Lewis Run	1595-1604 small oil prod.	1789-1795 small oil prod.	1591-1600 small oil; s.w.	1575-1583 small oil prod.	1598-1607 small oil pro
Kane			Stray 1642-1650 Kane 1804-1816		
Haskell			1945-1962		
Total depth ..	1632	1828	2030	1618	1642
Date completed	Aug. 26, 1935		July 8, 1935	Nov. 7, 1935	Oct. 7, 193

72	73	74	75	76	77
2265	2265	2265	2265	2265	2265
Dent-Whitney 106	Dent-Whitney 134	Dent-Whitney 96	Dent-Whitney 94	Dent-Whitney 120	Dent-Whitney 99
Minard Run Oil Co.	Minard Run Oil Co.	Minard Run Oil Co.	Minard Run Oil Co.	Minard Run Oil Co.	Minard Run Oil Co.
2120 42 466	 50 525	1911 513	1914 368	1812 70 434	1779 400
1357-1386		1108-1139	1127-1142	1036-1045	990-1018 Gas pocket 1063-1067
1545-1560		1210-1239 a little gas	1210-1230	1110-1118	show of oil**
own 1687-1695 ight show oil	1352-1377 brown 1431-1440	1330-1370 a little gas 1386-1394 a little gas	1351-1382 a little gas	1252-1277 1293-1308 1324-1329	1228-1251 1278-1285
1732-1738 1745-1748		1412-1422 show oil	1428-1438 a little gas	1367-1397*	1303-1310 10 M. gas
1940-1973 some s.w.	1694-1722 shot	1675-1705 some s.w.	1687-1714 show oil, some s.w.		1554-1586 show oil; s.w.
2046-2052 how oil, shot	1810-1816 shot	1792-1798 shot—small oil producer	1793-1800 shot—3 bbl. oil well		1663-1669, shot small oil prod.
2232-2284					
2284 May 25, 1939	1842 Dec. 19, 1940	1823 Jan. 13, 1938	1830 Sept. 30, 1937	1423	1698 April 21, 1938

* Flowed 500 bbls. per day.
** Stray: white 1174-1182; black 1182-1190.

83	84	85	86	87	88
2265	2265	2265	2265	2265 Dent-Whitney 101	2266 No. 7
ent-Whitney 77	Dent-Whitney 89	Dent-Whitney 88	Dent-Whitney 86		
Minard Run Oil Co.	Minard Run Oil Co.	Minard Run Oil Co.	Minard Run Oil Co.	Minard Run Oil Co.	Bovaird and Canan
1703 397	1731 536	1769 547	1779 550	1713 418	1702 85 720
955-978				943-952 little s.w.	
1084-1106		1241-1300		1050-1062 show oil	
1215-1236				1190-1220 10 M. gas 1236-1244 brown 1268-1275	
1310-1320	1337-1347	1387-1394 show oil	1410-1416		
1544-1570	1584-1600	1635-1664	1660-1680	1526-1550 show s.w.	1574-1601 oil
1628-1636 small oil prod.	1663-1671 small oil prod.	1713-1725 small oil prod.	1731-1739 small oil prod.	1608-1615 show oil	
				Stray 1670-1678 Kane 1815-1850 1940-1947	1841-1866 Stray 1901-1917
1663 Dec. 17, 1935	Dec. 16, 1936	1760 Nov. 12, 1936	1773 Oct. 4, 1936	1962 May 14, 1938	1927

Table 1. Selected well records, Lafayette Township—Continued

Map number ..	89	90	91	92	93
Warrant number.	2266	3412	3412	3435	3435
Property and number ..	Dent 4	Gates No. 1, Lot 10	Noles Tract No. 1	Noles Tract No. 7	Noles Tract No. 5
Owner	A. E. Booth	Paul E. Kahle	Foster and Burns	Foster and Burns	Foster and Burns
Elevation	1654	2089	2041		2045
Drive pipe	154	60	25	65	11
Casing	610	375	324	345	295
Bottom of Olean.					
"Red rock"		480-95, 530-45			650-35 M. gas
"Pink rock" ...		1038-1059			
Sands:					
Bradford First.	960-	1364-1405 dry			1350-1380
Sugar Run ...		1459-1466 gas, show oil			
Chipmunk		1586-1601 white	1486-1526 show oil		
Bradford Second		gray 1655-1683			
Harrisburg Run.	1264-	brown 1697-1725	1686-1726		
Sliverville		1735-1738 hard shell, show gas	Stray 1776-1792	1727-1740 100 M. gas	1707-1725 dry
Bradford Third.	1529-1559 oil	1969- salt water	1962-1999 s.w., show oil		1943-1983 show oil, s.w
Lewis Run			2089-2103		2050-2059
Kane	1780-1804 show oil		Stray		
Haskell	Stray 1861-1868		2157-2164		2422-2437*
Total depth ..	1915	1990		1820	2555
Date completed		1939	1938	1940	Dec. 12, 193

* Stray 2515-2555, show gas and oil.

Map number ..	100	101	102	103	104
Warrant number.	3435	3435	3435	3435	3903
Property and number ..	Northwestern X-1	Catherine P. Horton 1	Lot 6, No. 1	E. H. Bryner No. 1	Dent-Whitney 102
Owner	Healy Petroleum Corp.	Arthur C. Simmons et al.	Geo. McKinney et al.	Geo. McKinney et al.	Minard Run Oil Co.
Elevation	2168	2180			1981
Drive pipe	24			32	
Casing	325			453	375
Bottom of Olean.		187			
"Red rock"	495-525†	516-797	465-805	484-749	
"Pink rock" ...	1020-1211‡	923-1226	1194-1225	**	
Sands:					
Bradford First.	1445-1483	1455-1503			1283-1325
Sugar Run ...	1517-1524		1458-1505	white*** 1473-1486	
Chipmunk	1566-1600	1608-1614	1582-1622		1474-1492 some gas
Bradford Second	brown 1719-1734	1746-1765 gas 1751-1756	1654-1687	white 1665-1676	1583-1587 white shell
Harrisburg Run.	brown 1750-1763	1785-1794 show oil		brown 1746-1750	1611-1617 brown, show c
Sliverville	1763-1793 oil	1810-1820	1786-1788		stray, light brown 1729-1737
Bradford Third.				2021-2055 show oil & s.w.	1865-1891 s.w. & show c
Lewis Run				2115-2120 dry	1955-1960 s.w. & show c
Kane					
Haskell					
Total depth ..	1820	1878	1892	2153	1960
Date completed		1938		1940	June 21, 193

† White sand 670-690, 750-805.
‡ Sand 805-845.
** Show of gas in Stray sand 840-862, 1010-1025.
*** Show oil and gas at 1478.

94	95	96	97	98	99
3435 Noles Tract No. 4	3435 Noles Tract No. 3	3435 Noles Tract No. 2	3435 Intake No. 1	3435 Mayo Lot 1	3435 Northwestern X-10
Foster and Burns	Foster and Burns	Foster and Burns	Bingham Petroleum Corp.	F. D. Hill et al.	Healy Petroleum Corp.
2029 16 287	2047 43 340	2054 20 340	2149 14 446	2115 26 415	2146 40 380
				515-660 752-800 1050-1280	
				1431-1440 show oil	
				1576-1584	
1611-	1637- 1670-1690 show oil	1690-1714	1785-1800	Gray 1710-1718 1736-1744	1710-1741 1760-1765
1685-1786 small oil prod.	1711-1714 show gas	Stray, dry 1790-1811	1818- show gas	1760- §	1771-1811¶
		1962-1978 salt water			
1810 June 6, 1939	1774	1978	1900	1810 1939	1814 1938

§ 500 bbls. oil first 2 hrs. ¶ 150 bbls. oil per hr. 1000 M. gas.

105	106	107	108	109	110
3903 Dent-Whitney 84	3903 Dent-Whitney 82	3903 Dent-Whitney 56	3903 No. 21	2263 Johnston Lot D, No. 5	2263 Bingham Lot 206, No. 390
Minard Run Oil Co.	Minard Run Oil Co.	Minard Run Oil Co.	Moody & Moody	Associated Producers Co.	Associated Producers Co.
1813 550	1833 584	1956 43 465	2170 14 403	2031 393	2150
s.w. at 525	s.w. at 570	9		40' above well	460-780 1120-1138
	1154-1165 white				1452-1480 1510-1521
					1571-1610
	1467-1485		1787-1812		
1700-1719 salt water	1720-1742	1910-1928 oil	2096-2109 show oil	1902-1945 oil	2004-2051 oil
1771-1779	1788-1801 small oil prod.				
	Stray 1832-1836				
1809 July 16, 1936	1838 June 13, 1936	1957	2542	1945	2051 Oct. 2, 1927

Table 1. Selected well records, Lafayette Township—Continued

Map number ..	111	112	113	114	115
Warrant number.	2263	3410	3410	3410	3410
Property and number ..	Johnston No. 78	Glenn Charles	John W. Becker No. 5	John W. Becker No. 13	John W. Becke No. 1
Owner	Associated Producers Co.	W. S. Weed & Co. Devonian Oil Co.			
Elevation	2073	1843			2060
Drive pipe			44		24
Casing	367	371	344		375
Bottom of Olean.	13' above well				
"Red rock"			390-527		425-562
"Pink rock" ...			820-1180		825-1185
Sands:					
Bradford First.		1140-1170 hard, tight	1305-1383 gray		1372-1428
Sugar Run ...			1435-1505 gray		1480-1532 white
Chipmunk ...					
Bradford Second			1590-1632 gray	1685-1688 good show oil	1664-1680 white
Harrisburg Run.		1471-1500 show oil & gas	shot 1612-22 1649-66 brown shot 1647-65	1708-1725‡	1700-1720 brown
Sliverville			Stray gray 1761-1774	1731-1737 2 bbl. oil 10 M. gas	1730-1743§ gray
Bradford Third.	1936-1975	1741-1785*	1924-1968 brown, s.w.		1974-1991¶
Lewis Run					
Kane	2210- gas	2045-2075†			
Haskell					
Total depth ..		2178	1976	1825	1991
Date completed		Nov. 30, 1897		Oct. 24, 1940	1939

* Good sand, very little show of oil.
† Poor sand, very little show of oil.
‡ Slight show of oil in brown bottom.
§ Stray gray 1803-1840, 1850-1900.
¶ Slight show oil 1982-1987, s.w. 1991.

Map number ..	122	123	124	125	126
Warrant number.	2256	2257	2257	2258	2258
Property and number ..	No. 71	Bowen 3	Bingham 68-R	Bingham 97-J	Johnston 158
Owner	South Penn Oil Company	Jas. F. Magee	Johnston and Matthews	Johnston and Matthews	Associated Producers Co.
Elevation	2094	2092	2093	2121	2119
Drive pipe					
Casing					392
Bottom of Olean.		coal‡			
"Red rock"					
"Pink rock" ...					
Sands:					
Bradford First.					
Sugar Run ...					
Chipmunk					
Bradford Second					
Harrisburg Run.					
Sliverville					
Bradford Third.	2027-2064 oil	2024-2042	2010-2040 oil	2014-2044 oil	1998-2041 oil
Lewis Run					
Kane			2290-2307	2285-2305	2262-2291 gas
Haskell					
Total depth ..	2080	2658	2323	2330	2291
Date completed					

‡ Alton coal 25 ft. above top of well.

116	117	118	119	120	121
3410 ohn W. Becker No. 2	3410 John W. Becker No. 3	3410 John W. Becker No. 4	3410 John W. Becker No. 7	3423 Berwald No. 3	3433 Berwald No. 1
				McKinney and Williams	Berwald and Odell Oil Co.
2055 19 342	2065 19 365	 15 346	2038 22 408	 510	1906
410-575 840-1180	425-560 825-1185	400-535 840-1185	425-615 860-1180		77' above well
1370-1426 1478-1525 white	1373-1428 s.w. 1400-1428 brown 1480-1490 white 1500-1539	1370-1426 1474-1497 white	1378-1439 gray	1300-1330	
			1565-1578 gray	1460-	
	1652-1700 white		1676-1694 gray		
1699-1729 brown	1708-1732	1698-1715 brown	1715-1725 brown	1620-1626 brown	1616-1648 show of oil
stray gray 1806-1829	gray to dk. gray 1754-1776*	1715-1767 gray†	gray 1740-50 gray 1766-73		
					1857-1871 show oil, s.w.
1860 1939	1853 1939		1812 Jan. 13, 1940	1821	1871 1926

* Gray 1792-1802. † Shot 1716-1751 oil producer.

127	128	129	130	131	132
3408 No. 2	2254 R. J. Gates	3404 No. 3	2245 Lot 137, Lafayette 7	2246 No. 2	3402 No. 1
E. A. Williams and Sons	Ward Gunchen et al.	Geo. Kroh et al.*	W. C. Kennedy and Co.	C. L. Baker	South Penn Oil Company
1752 50 460	2125 12 379	1584	1886 341	2104 30 375	1530 66 422
	coal 45-48			Coal 45-46	
		1110-1180 white		1595-1600	1065-1125
1426-1469 brown§		1297- brown		1725-	
				Stray sand 1973-1980	
	2068-2106¶	1535-1575 salt water	1792-1866 oil	2038-2103†	1504-1536§
					1625-1650 show oil & gas
	2322-2327 5 M. gas 2559-2576** 7 M. gas	1825-1855 broken 2075-2095 10 M. gas	2037-2092	2281-2290 2307-2314‡	1775-1795 2015-2040 fair gas
1567	2707	2122 August 1939	2190	2525 Summer 1913	2044 March 31, 1919

§ Slight show of oil 1444-1452.
* Thundershower Gas Co.
‡ About 75 M. cu. ft. gas.
¶ ¾ bbl. oil, 1½ bbls. salt water.
† Much salt water about 1/3 bbl. oil after shot.
§ Little oil and much salt water.
** Stray 2645-2649.

Table 1. Selected well records, Lafayette Township—Concluded

Map number ..	133	134	135	136	137	138
Warrant number.	3399	3399	3399	3399	2244	2243
Property and number ..	No. 1	L. D. Wilson 15	L. D. Wilson 13	P. Newell No. 10	Demps-Cork No. 35	No. 38
Owner	South Penn Oil Company	South Penn Oil Company	South Penn Oil Company	Demps Petroleum and Gas Company	Sloan and Zook	Emery and Simpson
Elevation		1561	1565	1624	1975	2014
Drive pipe				20	25	
Casing				296	460	338
Bottom of Olcan.					46′ above well	
"Red rock"				Top, 19	355-540	
"Pink rock" ...					1145-1160	
Sands:						
Bradford First.				964-999		
Sugar Run ...	950-1040				1374-1378	
Chipmunk						
Bradford Second				1264-1289		
Harrisburg Run.					1637-1655	
Sliverville						
Bradford Third.	1509-1540	1484-1542 oil	1494-1538 oil	1564-1600 oil	1906-1961 oil	1938-1982 oil
Lewis Run	1610-1626					
Kane	1825-1837					2170-2184¶
Haskell	2022-2032					
Total depth ..	2246	1542	1546	1600		2259
Date completed				Jan. 28, 1897	1929	Feb. 1929

¶ Some gas 2213-2229, 175 M. cu. ft. gas 750 lb. R. P.

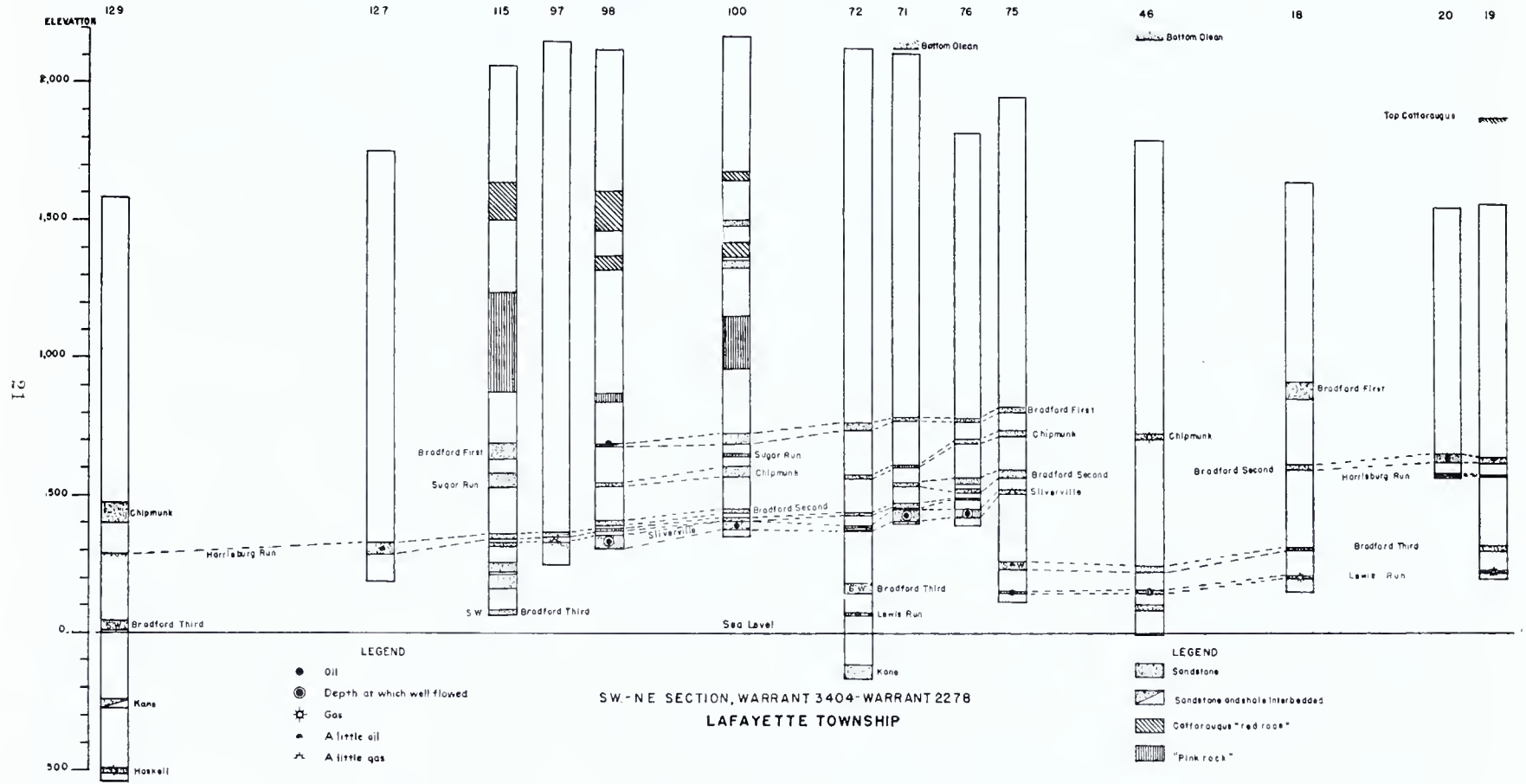


Figure 2. Southwest-northeast section, Warrant 3404—Warrant 2278.

In Figure 2, a series of well sections, selected from Table 1, has been arranged to show graphically the position of the sands with respect to sea level and important key beds along a southwest-northeast section starting with well 129 in Warrant 3404 and ending with well 19 in Warrant 2278. Similarly, in Figure 3, a northwest-southeast section is shown starting with well 31 in Warrant 4910 and ending with well 107 in Warrant 3903. The intervals between the base of the Olean, the top of the Cattaraugus red beds, and the important sandstone zones of the Conneaut and Canadaway groups, respectively, and the top of the Bradford Third sand in Lafayette Township are summarized in Table 2.

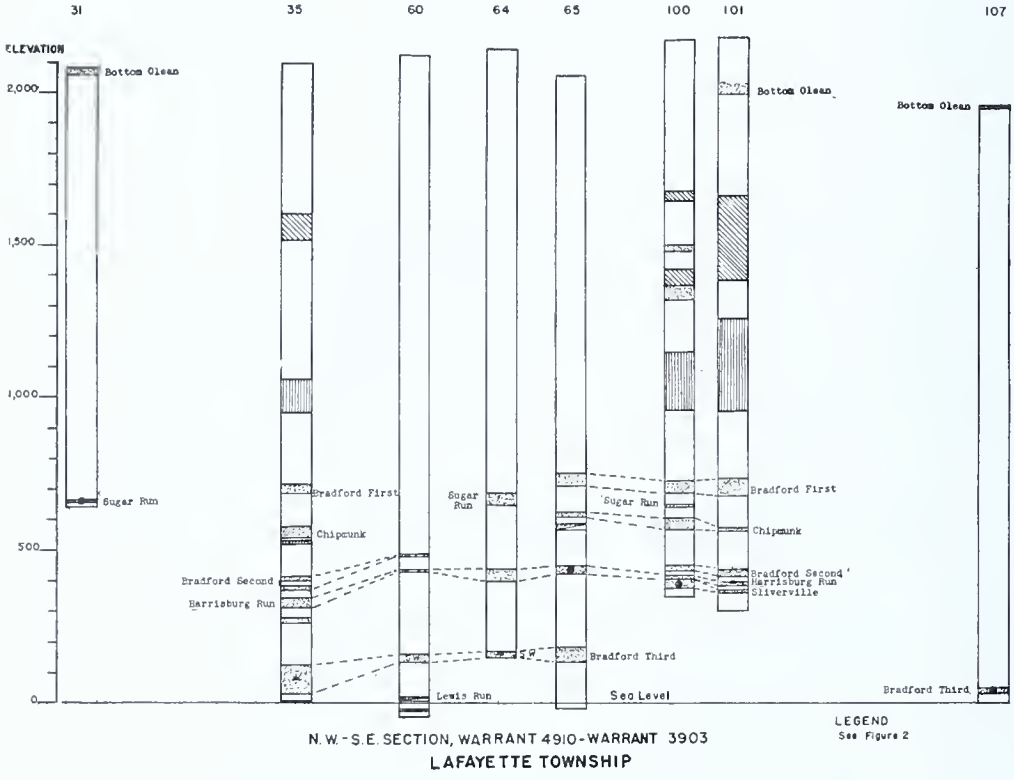


Figure 3. Northwest-southeast section, Warrant 4910—Warrant 3903.

Table 2. Intervals in feet between important horizons and top of Bradford Third sand in Lafayette Township.

	Average	Minimum	Maximum
Base of Olean	1929	1898	1952
Top of "red beds"	1531	1476	1551
Top of sand zones:			
Bradford First	585	560	619
Sugar Run	520	489	559
Chipmunk	455	383	484
Bradford Second	325	282	383
Harrisburg Run	261	238	289
Sliverville	244	208	263
Bradford Third	0	0	0
Lewis Run	104	68	146
Kane	271	231	316
Haskell	485	414	540

DESCRIPTION OF THE OIL AND GAS SANDS

BRADFORD FIRST SAND

The Bradford First sand at the base of the Conneaut group, where present in Lafayette Township, is a fine-grained, light greenish-gray sandstone. No commercial production, either oil or gas, has been encountered in it. Usually it is a dry sand but occasionally a little salt water is encountered and light shows of oil have been reported.

SUGAR RUN SAND

The Sugar Run sand is the productive horizon in southern Corydon Township, which adjoins Lafayette on the northwest. In this area, the sand is usually separated into two parts. The upper bed, three to eight feet thick, consists of medium-grained white quartz sandstone. Ten to twenty feet below it is a lower hard, light gray, quartz sandstone, 60 to 80 feet thick, the lower 10 to 20 feet of which also yield oil locally. The upper "pay" is sometimes called the Watsonville and the lower, the Dewdrop. The eastern edge of the Klondike pool of southern Corydon Township, which produces from the Sugar Run sand, extends a short distance into Lafayette Township in Warrants 3414 and 3416. Outside this area a white to gray or occasionally a brownish-gray sand in this zone has been reported in only a few wells in Lafayette Township. In most wells it is dry, but in some wells small volumes of gas and slight shows of oil are encountered in it.

CHIPMUNK SAND

A white to gray sand at the Chipmunk horizon is encountered in many wells in Lafayette Township. Commercial volumes of gas were formerly obtained from this sand in Warrants 2276 and 2277, but the supply is now exhausted. In other parts of the township the sand is usually dry. Only occasionally are small volumes of gas and light shows of oil present.

BRADFORD SECOND SAND

The Bradford Second sand is a fairly persistent fine-grained, light gray to light brownish-gray sand in Lafayette Township. The small oil pool near Marshburg in the northwestern part of the township produces from this horizon. A little oil has also been obtained from it south of the Erie Railroad station at Lewis Run. Outside these areas, mostly the sand has been dry. Only rarely are small volumes of gas, shows of oil, or small quantities of salt water encountered.

HARRISBURG RUN SAND

The Harrisburg Run sand is a thin, not very persistent, fine-grained, grayish-brown to chocolate-brown sandstone. The "brown" sand of the drillers, which overlies the "pay" sand in the Music Mountain pool occurs at this horizon. Occasionally good shows of gas and oil are reported in the sand and a few wells west of the Music Mountain pool have been small oil producers. In most places the sand is dry.

SLIVERVILLE SAND

The producing sand of the Music Mountain pool consists of a "shoestring" type of sand body approximately 4 miles long and only 800 to 2,000 feet wide. The sand was named Sliverville after an old settlement along Lewis Run above the borough of Lewis Run by E. H. Bryner, superintendent of the Minard Run Oil Company, shortly after the pool was discovered. It appears to be a local development only, as rarely is any sandstone encountered at this horizon outside the limits of the Music Mountain pool. The sand has not been found in many wells drilled only a short distance outside the limits of the pool on either side.

Typically, the Sliverville sand consists of a medium to coarse-grained, in part conglomeritic, light gray to light brownish-gray sandstone. Ten fragments recovered after a shot from Mallory and Williams No. 1 well, Lot 3,

Warrant 3436 possessed total porosities of 1.6, 3.6, 4.8, 5.1, 6.7, 9.9, 10.3, 13.0, 15.5, and 15.6 percent by volume. The fragments ranged from thoroughly cemented to only slightly cemented. A screen analysis of one of the loosely cemented, friable fragments from the above well is given in Table 3.

Table 3. Screen analysis of Sliverville sand from Mallory and Williams No. 1 well, Lot 3, Warrant 3436.

Size of openings, millimeters		Percent by weight	Size of openings, millimeters		Percent by weight
Through	On		Through	On	
	1.651	.8	.295	.208	7.7
1.651	1.168	.3	.208	.147	7.9
1.168	.838	2.0	.147	.105	5.2
.838	.589	14.1	.105	.074	3.9
.589	.417	33.2	.074	.053	1.2
.417	.295	19.4	.053		4.2

Total porosity, percent by volume, 13.0.

The quartz grains are subangular to angular. Silica, as a secondary crystalline outgrowth from the original quartz grains, and a small amount of calcite form the bond. Calcite and related carbonates are most abundant in the more tightly cemented portions. Thin greenish-gray clay seams and clay pellets were observed in some of the larger fragments.

The following section of the lower portion of the Sliverville sand, cored with a rotary rock bit, was obtained in the Williams Producing Company's No. 1 well, Lot 8, Warrant 3435:

Section of lower portion of Sliverville sand

Thickness Feet		Feet	Feet
	Top of Sliverville sand	1733.0	.....
1.7	Sandstone, coarse-grained, light brownish-gray	1753.0	1754.7
1.8	Shale, gray, with some interbedded medium-grained, gray sandstone	1754.7	1756.5
3.2	Sandstone, coarse-grained, light brownish-gray	1756.5	1759.7
.3	Shale, gray	1759.7	1760.0
4.6	Sandstone, coarse to very coarse-grained, light brownish-gray, with a little interbedded fine gray conglomerate and gray shale	1760.0	1764.6
.3	Shale, gray	1764.6	1764.9
4.9	Sandstone, coarse-grained, light brownish-gray	1764.9	1769.8
.5	Shale, gray	1769.8	1770.3
.3	Sandstone, medium-grained, light brownish-gray	1770.3	1770.6
.6	Shale, gray	1770.6	1771.2
1.6	Sandstone, coarse to very coarse-grained, light brownish-gray, pebbly in lower portion	1771.2	1772.8
.7	Shale, gray	1772.8	1773.5
1.9	Sandstone, coarse to very coarse-grained, light brownish-gray.	1773.5	1775.4
.4	Shale, gray	1775.4	1775.8
.3	Sandstone, very coarse-grained, light brownish-gray	1775.8	1776.1
.6	Shale, gray	1776.1	1776.7
.8	Sandstone, coarse-grained, light brownish-gray, pebbly	1776.7	1777.5

A summary of the analysis of the above core made by the Arthur C. Simmons Core Testing Laboratory is given in Table 4. A section and porosity profile with permeabilities and saturations tabulated at the right are shown in Figure 4.

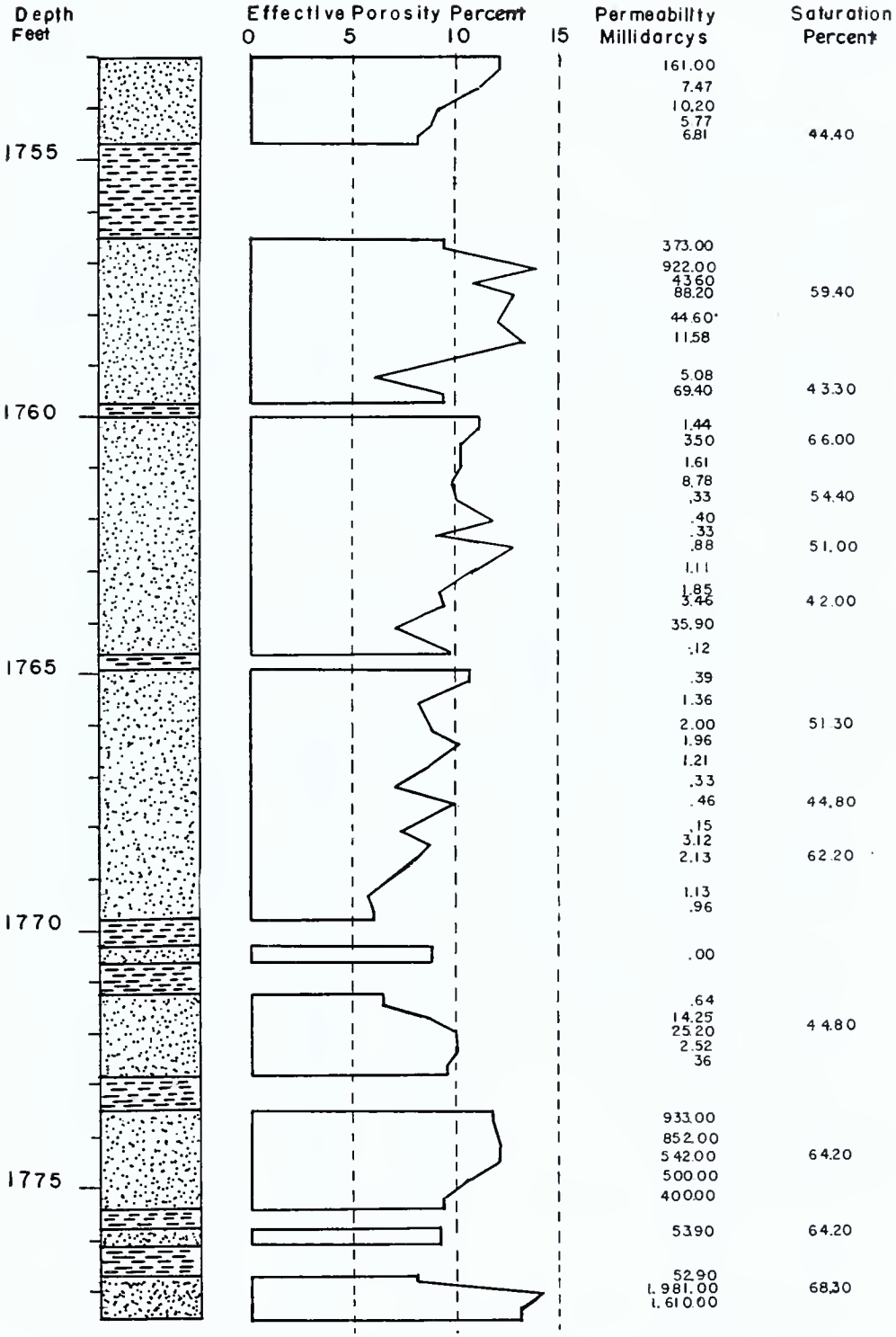
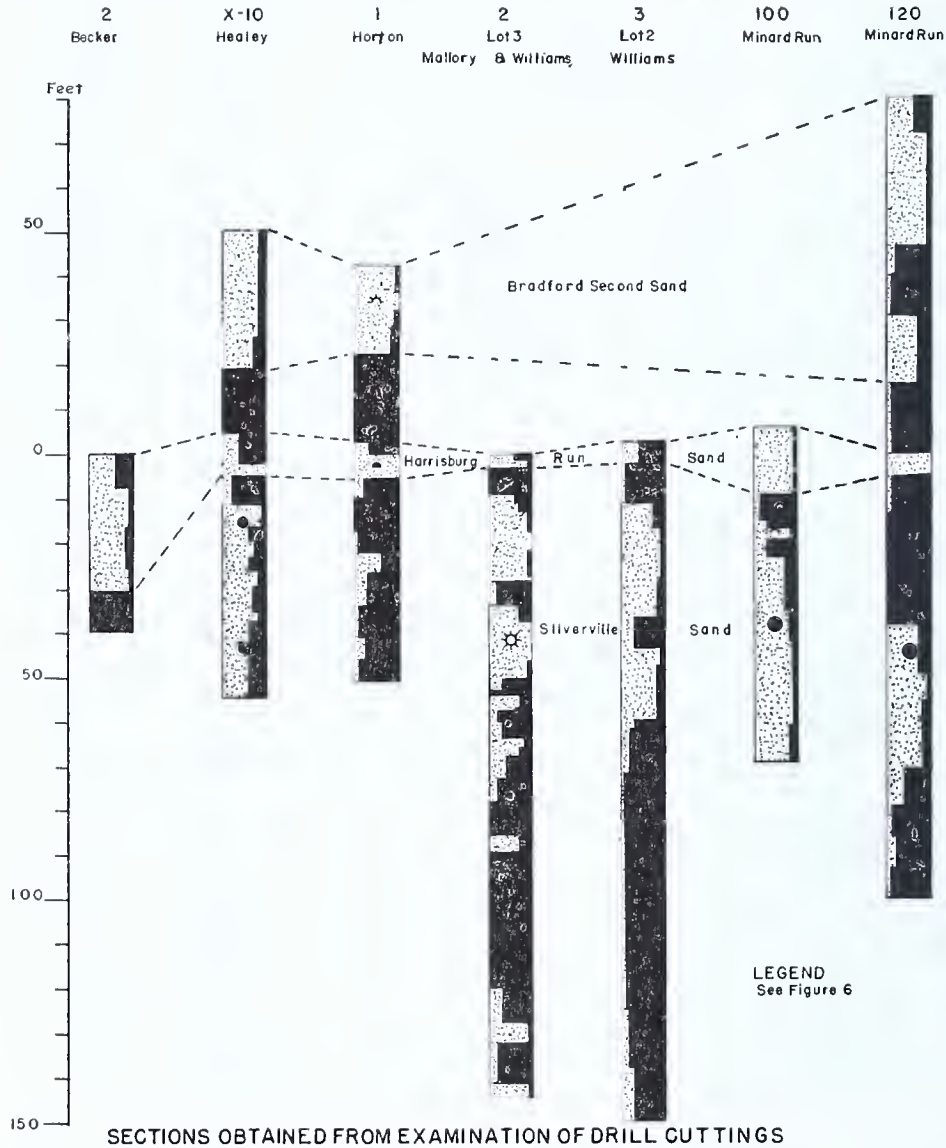


Figure 4. Section and porosity profile of Williams Producing Company No. 1 well.

Table 4. Summary of core analysis of Sliverville sand

Permeability	Net thickness of sand, feet	Average effective porosity, percent	Average oil saturation, percent	Barrels of oil, per acre	Average barrels of oil, per acre-ft.	Average permeabilities, millidarcys
0-10.0 millidarcys	11.7	9.11	50.4	4,167	356	2.11
10.0-100.0 millidarcys ...	3.8	10.28	50.0	1,517	399	41.38
Above 100.0 millidarcys ..	3.6	12.00	61.9	2,074	576	770.31
Maximum, 1,981.00. Total	19.1	9.89	53.0	7,758	406	154.71

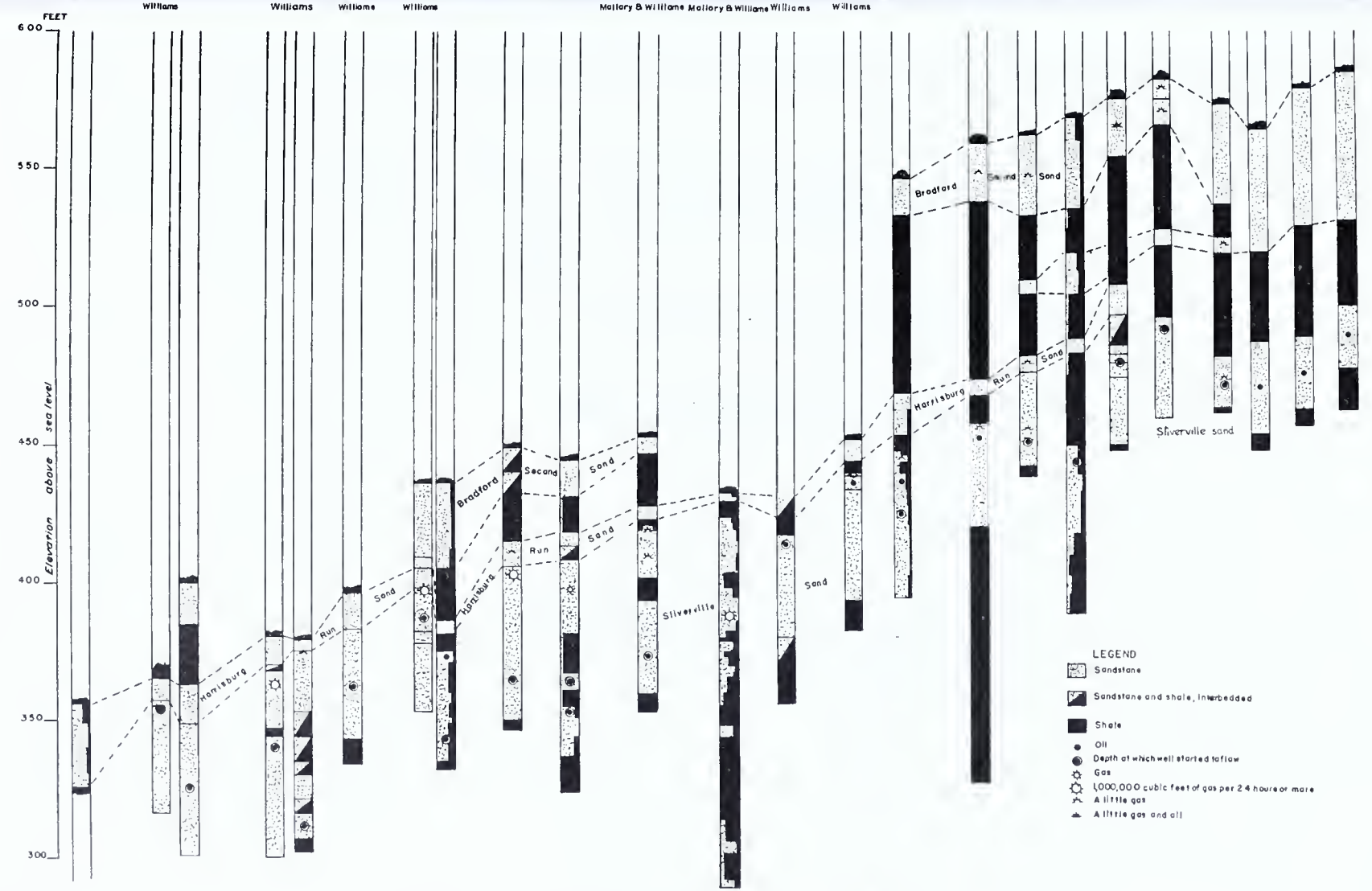
The relative amounts of sandstone and shale present in the Sliverville sand body, as determined by examination of drill cuttings of the sand, are shown in Figure 5. A series of well sections from southwest to northeast



SECTIONS OBTAINED FROM EXAMINATION OF DRILL CUTTINGS

MUSIC MOUNTAIN POOL

Figure 5.


FEET
600
550
500
450
400
350
300
Elevation above sea level
2 Becker
1 Lot 2 Williams
1 8 Bingham
6
7 Lot 7-25 Williams
2 Lot 7-25
10 Lot 8 Williams
1 Lot 8 Williams
X-10 Healey
X-12 Healey
X-3 Healey
8 Lot 3 Mallory & Williams
2 Lot 3 Mallory & Williams
7 Lot 2 Williams
8 Lot 2 Williams
100 Minard Run
110 Minard Run
107 Minard Run
Minard Run
Niagara
Niagara
Niagara
Niagara
Niagara
Bradford
Second Sand
Sand
Run
Harrisburg
Sand
Sand
Sand

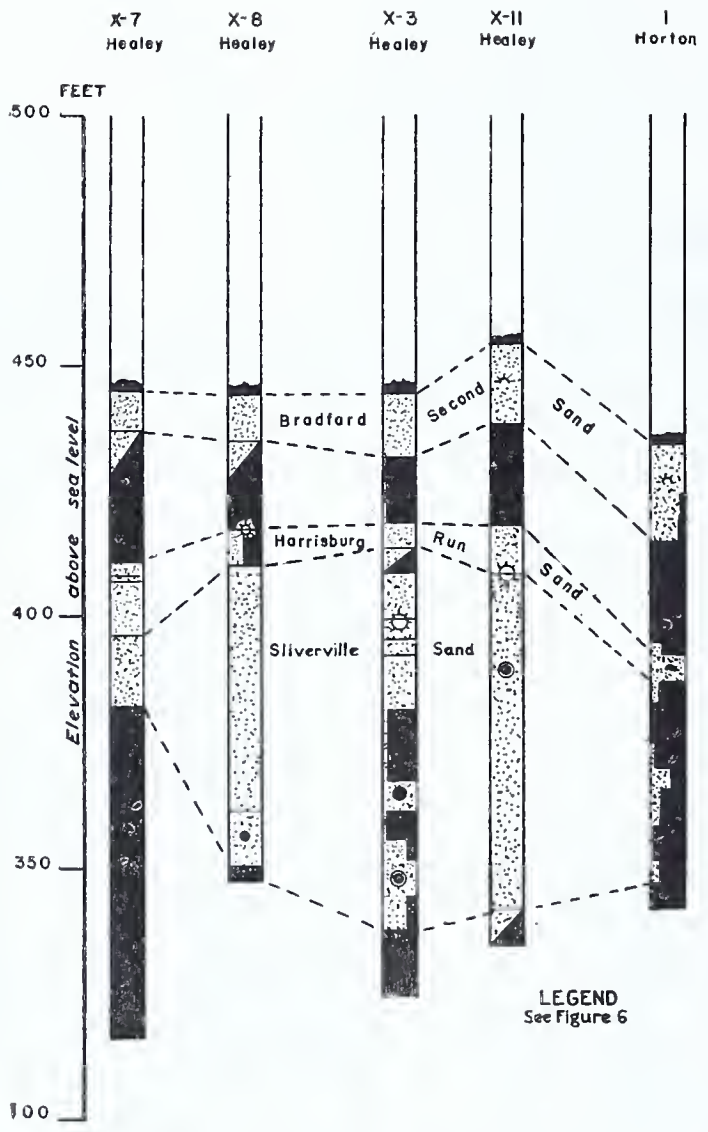


Figure 7. Northwest-southeast section, Music Mountain pool.

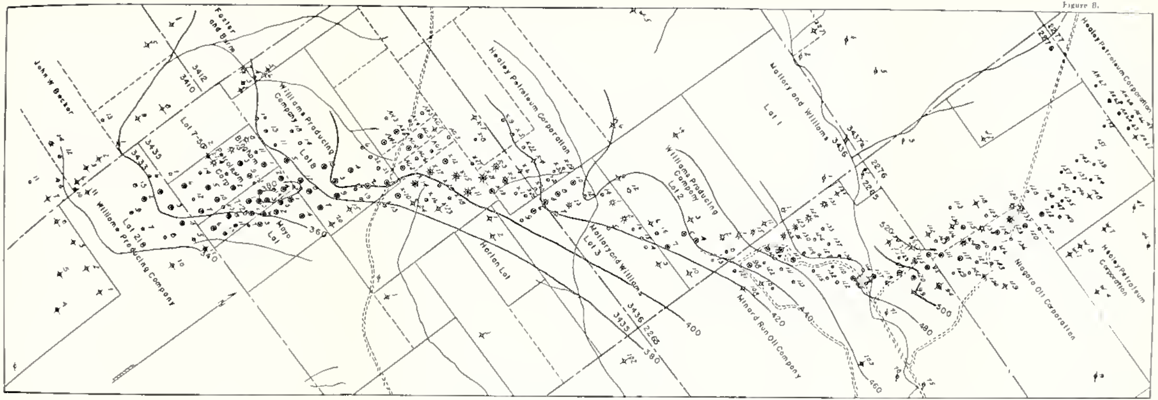
along the long axis of the Music Mountain pool and another series at right angles across the pool near the middle are lined up in Figures 6 and 7, respectively, to show the position of the Sliverville sand with respect to sea level and the Harrisburg Run and Bradford Second sands. It will be observed that in some places the Sliverville sand lies immediately beneath the Harrisburg Run sand and that elsewhere shale separates the two sands. The locations of the wells selected are shown on the map of the Music Mountain pool, Figure 8.

The outline of the Sliverville sand body and the shape of its cross-section suggest rather strongly that it represents an ancient off-shore bar.

BRADFORD THIRD SAND

The Bradford Third sand, the producing sand of the Bradford and Guffey pools, is a grayish-brown to chocolate-brown sandstone composed predominatingly of fine to very fine angular quartz grains. It has been described

Figure 8.



John W Becker
Foster and Byrne
Williams Producing Company
Lot 218
Lot 7-50
Bingham Petroleum Corp.
Hayo Lot
Williams Producing Company Lot 18
Healey Petroleum Corporation
Harlan Lot
Mallory and Williams Lot 3
Williams Producing Company Lot 2
Mallory and Williams
Lot 1
Minard Run Oil Company
Niagara Oil Corporation
Healey Petroleum Corporation
3410
3412
3435
3433
3436
2268
2276
2265
2277
2287
340
360
380
400
420
440
460
480
500
520

Chas. R Fettke
1940

MUSIC MOUNTAIN OIL POOL.

LAFAYETTE TOWNSHIP, MCKEAN COUNTY, PENNSYLVANIA.

Scale

0 1000 2000 3000 4000 5000 Feet.

Structure contours on top of Harrisburg Run Sand

Contour Interval 20 feet

LEGEND

Flowing Oil Well

Oil Well

Flowing Oil Well with Upper Gas Pay

Oil Well with Upper Gas Pay

Gas Well

Dry Hole in Sliverville Sand

Well Drilled prior 8-24-37

in considerable detail by the writer in an earlier publication.[7] Some sand has been encountered in the Bradford Third zone in practically every well that has penetrated it in Lafayette Township. Salt water is commonly reported in it in areas outside the productive pools.

LEWIS RUN SAND

The Lewis Run sand, the reservoir rock in the Lewis Run pool in the borough of Lewis Run and the area immediately to the southwest, is a fine-grained chocolate-brown sandstone ranging in thickness from six to twelve feet. In Warrants 2276, 2277, and 2278 it has yielded both oil and gas.

KANE SAND

The Kane sand is not a well-developed or a persistent sandstone in Lafayette Township. Usually this zone contains much interbedded shale. The sandstone layers are fine-textured, chocolate-brown, and in places calcareous. Gas has been obtained from the Kane sand along the Simpson anticline between Warrants 2263 and 2243. A well completed in this sand in Warrant 2243 as late as February 1929 had an initial open flow capacity of 175,000 cubic feet of gas per 24 hours and a reservoir pressure of 750 pounds per square inch.

HASKELL SAND

The Haskell sand, where present in Lafayette Township, also possesses a fine texture and a chocolate-brown color. Small volumes of gas have been obtained from it in Warrants 3402 and 3404 in the southwestern part of the township.

DESCRIPTION OF INDIVIDUAL POOLS

MUSIC MOUNTAIN POOL

The Music Mountain pool was discovered on August 24, 1937 when a wildcat well of the Niagara Oil Corporation, located on Music Mountain in the southwest corner of Warrant 2276, unexpectedly started to flow oil at the rate of 44 barrels per hour. The well was 1,639 feet deep and in a sand now known as the Sliverville. One week later the rate was down to 15 barrels per hour, but increased to 36 barrels when the well was drilled four feet deeper. Between August 24 and September 15, the well produced slightly over 6,000 barrels of oil.

The second producing well in the pool, located about 1,200 feet slightly west of south of the discovery well, was drilled by the Minard Run Oil Company on Warrant 2265. It started to flow at a rate of about 40 barrels an hour at a depth of 1,401 feet on October 26, 1937 and at one time flowed 500 barrels in two hours. A well previously completed 500 feet east of this well encountered only a little gas at the Sliverville horizon and one completed later, 500 feet west, obtained only a show of gas and oil. A well drilled April 6, 1899 through the Bradford Third sand in the northwest corner of Warrant 2265 was only 1,000 feet northwest of the edge of the Music Mountain pool.

By the end of 1940, 210 producing wells, including 14 gas wells and 68 wells non-productive in the Sliverville zone, had been drilled in this area. As shown in Figure 8, they define pretty well the limits of the Music Mountain pool. The productive area is a strip four miles long and only 800 to 2,000 feet wide, and includes approximately 670 acres. The area shown in Figure 8 lies outside the Bradford pool and had been drilled only sparsely prior to the discovery of the pool. About 17 wells had been completed in it through the horizon of the Sliverville sand.

A few of the larger wells began to produce at the rate of 500 barrels of oil per hour and several of the larger gas wells had open-flow capacities of from 5,000,000 to 15,000,000 cubic feet per 24 hours. The highest reservoir pressures reported ranged between 610 and 640 pounds per square inch.

[7] Fettke, Chas. R., The Bradford Oil Field, Pennsylvania and New York: Pennsylvania Geol. Survey, 4th ser., Bull. M 21, pp. 167-233, 1938.

The rate of production has been conservative. Four of the seven operators in the pool also have extensive holdings in the water-flooding territory of the near-by Bradford pool. Over-production in the Music Mountain pool would have seriously affected their water-flooding investments. Only a relatively small amount of the total potential production was taken during 1937 and 1938. Production, therefore, did not reach a peak until the early months of 1940, when for a short time it exceeded 7,000 barrels a day. It was curtailed again drastically in June 1940. Unrestricted production was not resumed until the end of the year. The estimated daily average production by months is shown graphically in Figure 9. The total production at the end of 1940 is estimated at 2,234,655 barrels.[8]

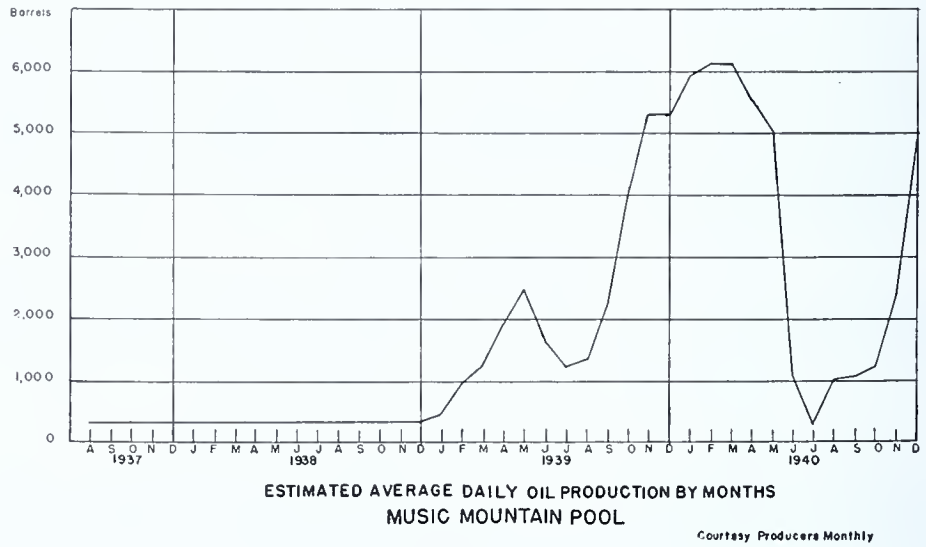

Barrels
6,000
5,000
4,000
3,000
2,000
1,000
0
A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1937
1938
1939
1940
ESTIMATED AVERAGE DAILY OIL PRODUCTION BY MONTHS
MUSIC MOUNTAIN POOL
Courtesy Producers Monthly

Figure 9.

Very little gas has been marketed from the pool, but several of the producers, who also have holdings in the Bradford pool, have used some gas to operate these properties. Almost all the operators have installed recycling units in order to maintain the reservoir pressure as long as possible. Gas-oil ratios were relatively high at the start, about 2,700 cubic feet per barrel of oil. With the use of a bottom-hole choke, however, it was found possible to lower this to 900 to 1,000 cubic feet per barrel. Large wells were completed either with a lubricator or occasionally with a small rotary outfit. The separation of paraffin from the oil, and its accumulation in the tubing has been a serious problem, particularly in the flowing wells. Although flowing wells were still being completed as late as the summer of 1940, almost all wells were being pumped at the end of the year.

The reservoir rock of the Music Mountain pool represents a shoe-string type of sand body. It is on the southeastern flank of the southwestward plunging Bradford anticline (Figure 1). The long axis of the sand body makes an acute angle with the axis of the fold, and the sand, therefore, rises gradually in a northeasterly direction. The reservoir represents a stratigraphic rather than a structural trap. The sand body has an average thickness of 35 feet in the pool as a whole, but locally the thickness ranges anywhere from 10 to more than 90 feet. Some shale is interbedded with the sandstone.

In many wells only gas was encountered in the uppermost layer of sand, frequently in large volumes. Other wells started to flow oil shortly after the sand had been penetrated. The wells that yielded much gas and little or no oil are confined to the northwestern edge of the pool. Salt water has

[8] Bauer, G. G., Crude oil output of Music Mountain area: Producers Monthly, vol. 5, January 1941, p. 10.

not been reported in the Sliverville sand. None of the marginal wells have encountered edge-water. The sand body thins rapidly beyond the margins of the pool. Shale layers interbedded with the sandstone increase in thickness and the sandstone layers become thinner and fewer and also finer in texture. In places wells less than 500 feet outside the limits of the pool have encountered only the brown Harrisburg Run sand. If any sand was present in the Sliverville zone, it was so insignificant that the drillers failed to recognize it.

An accurate estimate of the reserves of the Music Mountain pool cannot be made at present. No core of the entire thickness of the sand has been taken and only two or three partial cores have been obtained. The periods during which the pool has been operated at full capacity have been too limited to furnish a decline curve that can be projected into the future. Only a rough approximation of reserves, therefore, can be made.

A planimeter measurement of the area of the Music Mountain pool on a map drawn to a scale of 400 feet to the inch showed this to be 668 acres. The average thickness of the sand body, as obtained from well records, is 35 feet, but part of this represents shale partings. In the lower 24.5 feet of the total 44.5 of Sliverville sand in the Williams Producing Company's No. 1 well, Lot 8, Warrant 3435, 19.3 feet consisted of pay sand. A core analysis of this portion of the sand showed an average effective porosity of 9.89 percent and an average saturation of 53 percent. Inasmuch as the reservoir pressure at the time the core was taken was still sufficiently high to permit producing the well by flowing, the percentage of saturation obtained in the core analysis probably was low. On the other hand, in parts of the pool the pores in the upper part of the sand are filled largely with gas, and oil saturation may be much lower. On the assumption that the above core analysis is representative of the Sliverville sand as a whole, there would have been present originally in the Music Mountain pool a total of 7,500,000 barrels of oil. The Sliverville sand is more like the Venango sands than it is the Bradford Third in its physical characteristics. Dickey and Bossler find that the average saturation of the Venango sands at the time that they are depleted by primary methods of production is 22.8 percent and that the saturation can be reduced to between 12 and 15 percent by an intensive air drive.[9]

Analyses by the writer of Venango First and Second Sand cores, taken on properties in the Venango district which had been depleted by primary methods of production and on which air drives were later applied successfully, showed average saturations of 26.3 percent or approximately one-half the saturation found in the Sliverville Sand core. This would indicate that 3,750,000 barrels of oil should be recoverable by the present method of production from the Music Mountain pool. At the end of 1940, of this quantity 2,235,000 barrels had already been obtained.

MARSHBURG POOL

The Marshburg pool occupies approximately 235 acres in Warrants 3414 and 3437 in the northwestern part of Lafayette Township. The pool was opened late in 1929 by Mallory and Pringle. Their drilling program extended over a period of eight years. In the southwestern part of the pool the Williams Producing Company was still doing some drilling in 1940. At the end of the year there were 56 producing wells in the pool. Production is obtained from the Bradford Second sand. Wells started off at from 2 to 10 barrels of oil per day and are long-lived. At the end of nine years some still average one barrel per day.

The Bradford Second sand in the pool ranges from 8 to 19 feet in thickness, the average being 15 feet. Chip samples of the sand range in effective porosity from 5.5 to 14.5 percent, in permeability from .2 to 8.9 millidarcies,

[9] Dickey, Parke A., and Bossler, Robert B., Oil recovery by air drive in the Venango fields of Pennsylvania: Preprint, Division of Production, American Petroleum Institute, Nov. 13, 1940, pp. 4 and 10.

and in saturation from 28 to 51 percent. A lower pay, about 9 feet thick, from 19 to 38 feet below the main producing sand, is present in some of the wells. The Marshburg pool, Figure 1, is on the southwestward-plunging nose of the Bradford anticline. It represents a stratigraphic rather than a structural trap.

BRADFORD POOL

An area of about 115 acres is occupied by the northwestern lobe of the Bradford pool in Warrants 2277 and 2278, and 7,150 acres by the southeastern lobe in the central and eastern parts of Lafayette Township. Production is obtained from the Bradford Third sand. Almost all the oil recovered from this pool at present is obtained through the application of intensive methods of water-flooding, such as the "five-spot." The Bradford pool, including the part lying within the borders of Lafayette Township, has been described elsewhere in considerable detail.[10]

It is interesting to note that in the southwestern or Timbuck extension of the southeast lobe, stratigraphic features rather than structure were the controlling factors in determining the place of accumulation. The Timbuck extension cuts diagonally across the Big Shanty syncline.

GUFFEY POOL

An area of about 1,900 acres in the southern part of Lafayette Township is included within the Guffey pool. This pool occurs along the axis of the Simpson anticline south of the Bradford pool. The anticline, which has been lowering rather gently toward the southwest, increases in pitch at this locality and forms a rather prominent structural nose.

Oil production is confined to the Bradford Third sand. Considerable salt water and only small quantities of oil occur in the non-productive interval that separates this pool from the Bradford pool. Salt water also occurs in the sand around its southern margin.

Oil was discovered in the Guffey pool in 1878. Some of the larger wells are reported to have started at 30 to 100 barrels of oil per day. Today practically all the oil produced is being obtained from intensive water-flooding operations.

LEWIS RUN POOL

The Lewis Run oil pool, discovered in 1909, occupies about 1,100 acres in the borough of Lewis Run and adjacent territory in Lafayette Township on the south. Structurally it is on the relatively steep southeast flank of the Bradford anticline. Apparently the pool is in a local occurrence of a sandstone of suitable characteristics to act as a reservoir rock at a horizon 100 feet below the Bradford Third sand.

The area is the type locality for the Lewis Run sand and, within the limits of the pool, the oil production has been confined almost entirely to this sand. Initial production of the wells ranged from half a barrel to eight barrels. In some wells a little salt water occurred with the oil. In the gas-bearing area on the up-dip side, some wells had initial open flows of 65,000 to 390,000 cubic feet per day. The gas is now exhausted.

In recent years the Minard Run Oil Company has developed a small production from the Lewis Run sand southwest of the Lewis Run pool and along the same trend in Warrant 2265.

POTENTIAL OIL AND GAS PRODUCING AREAS

An inspection of Figures 1 and 8 indicates that enough wells have been drilled around the margins of the Music Mountain pool to define its boundaries. At the end of 1940 only a little room for extension remained at the

[10] Fettke, Chas. R., The Bradford Oil Field, Pennsylvania and New York: Pennsylvania Geol. Survey, 4th ser., Bull. M 21.

northern and southwestern ends. Other than these areas only inside locations remained to be drilled. It has been suggested, however, that the Sliverville sand of the Music Mountain pool represents an ancient off-shore bar. There is a possibility, therefore, that similar shoe-string sand bodies may exist at this horizon along the Music Mountain trend both north and southwest of the pool. These bodies may be discontinuous and perhaps slightly offset.

At the north end the possible territory is limited to the northwest quarter of Warrant 2277 in Lafayette Township and the southwest quarter of Warrant 2286 in Bradford Township. Beyond that the trend overlaps the area occupied by the northwest lobe of the Bradford pool, which has already been thoroughly tested in the Sliverville horizon.

In the southwestern part of Lafayette Township a strip along the Music Mountain trend, approximately 2.5 miles in length in Warrants 3404, 3408, and 3410, remained to be explored at the close of 1940. In the eastern part of Warrant 3410, wells 4, 10, and 11 were completed as small pumping wells in the Sliverville sand between the autumn of 1939 and the summer of 1940. Later in 1940, three more producing wells were drilled on Warrant 3410, namely, well no. 12, reported as having had an initial production of 500 barrels of oil and 500,000 cubic feet of gas per day; well no. 13, about 2 barrels of oil and 10,000 cubic feet of gas per day; and well no. 14, which started at the rate of 5,000,000 cubic feet of gas per day and later flowed oil. A reservoir pressure in excess of 500 pounds per square inch was measured in wells 12 and 14, in contrast to 240 pounds in wells 4, 10, and 11. The latter pressure represented about the reservoir pressure of the Music Mountain pool at the time. Apparently little or no leakage had occurred in the area occupied by wells 12 and 14. There is a possibility, therefore, that these wells may be at the northeast end of another lens, separated and slightly offset from the Music Mountain sand body, but along the same trend.

The Marshburg pool occurs in the Bradford Second-Cooper sand belt of pools. This belt overlaps the Bradford Third sand pool along its northwest margin in Bradford and Foster Townships, McKean County, and Cattaraugus County, New York, but, owing to its northeast-southwest trend, lies well to the west of the area in which the Bradford Third sand is productive in Lafayette Township. The possibilities of extending the productive acreage in the Bradford Second sand appear to be most favorable in the territory southwest of the Marshburg pool.

In the extreme northwest corner of Lafayette Township, there is a slight possibility that oil may occur along the trend of the Clarendon-Sugar Run Sand belt northeast of the Klondike pool across Warrant 3416. Production in the Klondike pool terminated where the porous and permeable sand wedged out. Any production northeast of it, therefore, would have to come from another lens.

The Bradford Third sand more nearly represents a sheet-type deposit in Lafayette Township than do any of the other sands described. Outside the oil-producing areas the sandstone commonly yields salt water. Although the occurrence of an unusually thick sand body in the Bradford Third sand zone was the factor of major importance in the accumulation of the Bradford oil pool, the sheet-like character of the reservoir rock permitted the structure to have considerable influence in determining the place of accumulation. An inspection of the structure of Lafayette Township (see Figure 1) does not reveal any areas favorably located from a structural standpoint that have not already been tested. There is a possibility, however, that, owing to particularly favorable local sand conditions, small amounts of productive acreage in the Bradford Third sand remain to be discovered in some of the sparsely drilled areas.

A small amount of gas has been obtained from the Kane sand along the Simpson anticline in the southeastern part of Lafayette Township. The

sand appears to be lenticular and only locally productive. Inasmuch as the strip along the anticline between the Bradford and Guffey pools has not been intensely drilled, it is quite probable that not all the lenses have been tapped and drained. In the southwestern part of the township, small volumes of gas have been encountered in the Haskell sand. The occurrences do not appear to be related to any structural feature.

The Haskell sand at present is the deepest sand from which commercial production, either oil or gas, has been obtained in the Bradford district. The Oriskany sand, about 2,500 feet below the Haskell, which in recent years has been the source of large volumes of gas in Potter and Tioga Counties, Pennsylvania, and adjacent parts of New York, is probably absent from the southeastern part of Lafayette Township.[11] Structure has been the important factor in determining the location of the gas pools in this sand in north-central Pennsylvania and south-central New York. Lafayette Township does not possess a favorable structural feature that would warrant an Oriskany Sand test.

The oil pools of McKean County and adjacent territory in each of the different sand zones are confined largely to distinct belts whose trends were determined by the positions of the ancient shore lines at the time the sands of the successive zones were deposited. Most of the individual pools occupy stratigraphic rather than structural traps. Even in the Bradford Third sand, the best-developed sandstone of the Canadaway oil sand group, the producing areas coincide very closely with the areas of thick, porous, and permeable sand development.[12]

Structure mapping, either surface or subsurface, is of no assistance in prospecting for pools of the Music Mountain type, nor has any geophysical method of exploration been perfected thus far for locating such pools. The first step, therefore, in investigating any particular area is to locate as completely as possible all old wells in the area and obtain all available information in regard to them. The data will be useful in determining whether a particular tract has been sufficiently prospected already or whether it still offers possibilities. The position of the tract with respect to the productive belts in the various sand zones is important. The above information should serve as a guide in locating further test holes.

In prospecting, complete sets of samples of drill cuttings from the surface down should be taken and studied so that the stratigraphic position of the sands encountered can be determined. An effort should be made to obtain at least "chip" samples of the important sands where coring is not feasible. By this means, it should be possible to determine whether any further prospecting at a particular locality is warranted. In certain areas, as data from several wells accumulate, it may be possible to work out certain trends along which production may be sought.

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[11] Fettke, Chas. R., Subsurface studies of Pennsylvania deep oil and gas sand explorations: Producers' Monthly, vol. IV, p. 34, June 1940.

[12] Fettke, Chas. R., Pa. Geol. Survey Bull. M 21, pp. 274-5.